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SIXPENNY TELEGRAMS.

OUR readers will join with us in satisfaction that an attempt is to be made by the Government to proceed with the Telegraph Acts Amendment Bill, and to give to the country at last something in the shape of a sixpenny telegram. The possibilities of the case have been so often discussed, in our columns and elsewhere, that it is not needful now to allude very fully to the various schemes which have been suggested as most likely to satisfy the public and give a fair return for the outlay necessitated. Lord John Manners, when in opposition, presented an unyielding front to the proposal of Mr. Shaw-Lefevre, the then Postmaster-General, to impose a charge for the transmission of addresses. We at the time admitted that there were difficulties in this connection, but stated our conviction that they were not insuperable. In the majority of cases, we felt assured, very few words would suffice to convey the information requisite to ensure the safe delivery of the message, and a fair number of words would then be left to embrace the communication proper. The plan, therefore, brought forward by Mr. Shaw-Lefevre met with our approval, for, while sympathising with the motive of Lord John Manners, we could not help recognising the improbability of the assent of the Treasury being obtained to any scheme which would involve a loss in working, and, to be worth anything, a sixpenny telegram which allowed of the full transmission of addresses without charge would inevitably be of that nature.

The suggestion attributed to the present Postmaster-General of a telegram of three words exclusive of addresses, which are to be free, we can scarcely think will be received with much favour; it will certainly not be so acceptable to the commercial community, nor any other community that we are acquainted with, as the scheme of his predecessor. It has been lately understood, however, that the Postmasters-General past and present would put their heads together and attempt to produce a measure which should meet with approval on both sides, and we are told to expect that the results of their collaboration will in a few days be before the world. The further consideration of the measure was to have taken place at the latter end of last week, but such are the difficulties in the way of dealing with Bills of this nature at the present stage of Parliament that a postponement was rendered necessary, and probably at the time of our going to press the expected communication from the two eminent gentlemen will be still to come. We can now only repeat our previously expressed hopes that something really useful will be offered to the long-suffering public, and that this will be done in such a manner and to such an extent that it shall not lead to that deficit which the Treasury authorities dread, and which should be deprecated by economists upon all accounts.

UNDERGROUND WIRES.

DURING the last few years the number of electric wires in all our large cities has rapidly increased, especially since the introduction of the telephone and the electric light; and the probability is, writes Dr. W. W. Jacques, the electrician to the Bell Telephone Company, in a communication to *Science*, that the next few years will show a further large increase. If these wires run on poles, they not only disfigure the streets, but seriously interfere with the operations of firemen, as we have repeatedly seen during the last few years. A cobweb of wires supported on housetops requires the linemen to continually tramp through the houses and over the roofs, causing annoyance to the tenants, and damage to the buildings. Moreover, wires fixed to housetops are subject to removal at the whim of the owner, and they have to be continually removed from building to building as the goodwill of each owner is exhausted. Again, overhead wires, whether placed on poles or housetops, are continually coming in contact with each other, causing annoyance and danger; and an extra heavy rain or sleet storm so entangles and breaks them as to entirely interrupt communication. The annual cost of repairs of overhead wires in cities is not less than 30 per cent. of the first cost of construction.

In almost all of the large cities the question is being asked, why cannot these wires be gathered into cables and buried, along with the gas and water pipes, under the streets? In answer, it is proposed to review briefly the technical difficulties that arise, and to show how they may be and are overcome. It is proposed, further, to compare the cost of construction and maintenance of overhead wires with the cost of construction and maintenance of underground cables, and thus to see which is desirable from economical considerations.

There are two reasons, apart from the difficulty of securing good insulation, why underground lines are comparatively inefficient:—

1. If an electric conductor be brought near to a large mass of conducting matter, as is a wire when it is taken down from a pole and buried in the earth, there appears in the current the phenomenon of retardation, by which each signal, instead of being sharp and distinct, is partly kept back, so that it overlaps and mingles with the next. The result is to limit the speed of working of the apparatus, or, if like the telephone, it be an apparatus in which the currents are necessarily extremely frequent, to confuse and destroy the signals altogether.

2. The second difficulty is called induction, and is noticed when two or more wires are run side by side and near together, as they necessarily are in an underground cable. If the signals on one wire of such a cable be sharp and quick they cause facsimile signals on all of the neighbouring wires; and this, too, though the insulation may be absolutely perfect. The result of this phenomenon is, that messages sent over one wire are liable to be received on all of the other wires; and in telephony each person can easily overhear all that the others are saying.

Fortunately, however, both of these difficulties vary with the electrical qualities of the cable; and while I have seen cables of a thousand feet, over which it was difficult to talk, and in which the cross-talk was nearly as loud as the direct conversation, on the other hand, I have conversed easily over an underground cable extending from Paris to Orleans, 85 miles; and this, too, while other parties similarly separated were talking over conductors of the same cable. There was absolute secrecy.

Last summer I visited France and Germany, and

made, together with Mr. Berthon (chief engineer of the French telephone company), Mr. Cäel (chief engineer of the French Government telegraph), and Herr Guillaume (constructor of the underground lines of the German Empire), a series of telephone experiments on underground lines, varying from 5 to 100 miles in length, from 2·87 to 48 ohms resistance, and from 0·06 to 0·35 microfarads capacity per mile.

These experiments furnish us with ample data from which to deduce the requisites of any cable in order that it may transmit speech, and without cross-talk from the neighbouring conductors. These are briefly as follows :—

1. Good conductivity.

2. High insulation ; for without this the current leaks from one conductor to the others, giving rise to cross-talk ; and it is possible to talk by direct leakage between two conductors whose insulation is several million ohms.

3. Low specific inductive capacity ; for the greater the capacity the greater the retardation, and the greater also the cross-talk due to induction.

Below is a table showing the specific inductive capacity and insulation of various insulators. The measurements were all made on a wire 0·05 of an inch in diameter, coated with insulation to a thickness of 0·10 of an inch.

Cable.	Maker.	Insulation per mile in megohms.	Specific inductive capacity in microfarads.
Gutta-percha	Siemens Bros., London ...	190	4·2
India-rubber	Rattier, Paris	170	3·7
Renti . . .	A. G. Day, New York ...	150	4·0
Faraday . .	Faraday Cable Works, Cambridge, Mass	15,000	1·6
Patterson .	Western Electric Company, Chicago	450	3·1
Brooks . .	David Brooks, Philadelphia.	...	2·8

Let us take a special case, and compare a gutta-percha cable having a specific inductive capacity of 4·2 with a Faraday cable of 1·6. The table predicts that we can talk three times as far with the latter as with the former, and experiment shows that we can. Again, the cross-talk on the gutta-percha cables ought to greatly exceed that on a Faraday cable ; and experiment has shown that, while conversation over a two-mile gutta-percha cable was continually disturbed by existing cross-talk, conversation was carried on over a similarly constructed Faraday cable five miles in length without the cross-talk being appreciable.

By proper attention to the electrical qualities, then, we may talk underground a much greater distance than we shall ever have reason to in any city system, and this without cross-talk from the neighbouring circuits.

We have seen that telegraph and electric lighting currents are not subject to the technical difficulties we have been discussing, and that, provided good conductivity and good insulation are assured, it is with them purely a question of expense. Let us, then, determine the relative expense of overhead and underground wires.

Suppose we have a large city with a telegraph office near the centre, and that it is desired to carry a hundred wires to the city limits, say, three miles distant. Let us suppose that the wires for the first mile rest on housetops, and for the remainder of the distance on poles. The cost will be :—

35 roof-fixtures, at $45	$1,575
80 poles, with arms, &c., at $65	5,200
300 miles No. 9 wire, at $16	4,800
Stringing 300 miles wire at $8	2,400
Total	$13,975

Underground the cost would be :—

6 miles (50 conductors) No. 17 lead covered cable, at $3,000	$18,000
3 miles trenching, troughing, laying and refilling, at $2,000	6,000
Total	$24,000

That is, the relative first cost of an overhead and an underground line, to do the same work, would be, say, $14,000 and $24,000.

The same conclusion will hold true for telephone wires, provided we confine ourselves to the problem of running out from the central office, by 50 or a 100 conductor cables, to a large number of distributing points so situated about the city that any subscriber would be easy of access, by a short overhead line, to one or another of them ; and this is the problem that really occurs. So much for construction.

The yearly cost of repairing an overhead system, including roof-rentals, is not less than 30 per cent. of the cost of construction ; and the line would have to be renewed once in twelve years. The cost of repairing an underground system is practically *nil*. The Paris Telephone Company, with wires extending to 3,000 subcribers, does not keep any repair men. The durability of an underground system, provided lead covered cables are used, and there is no internal cause of deterioration, is at least 30 years. Last summer we examined some lead-incased gutta-percha cables that had been in use by the French Government for that length of time, and found them in perfectly good condition. The same is true of India-rubber cables incased in lead.

Herr Guillaume says of a cable in use by the German Government, similar to the Faraday cable, "We are using it altogether in our new construction. I do not see how it can ever decay. We tried cotton covered wires soaked in paraffine and drawn into lead pipes ; and, though they worked well at first, after a few years they failed."

A HIGH-PRESSURE INFLUENCE ELECTRIC MACHINE.

By WALTHER HEMPEL.

IN January, 1884, I published in the *Berichte der Deutschen Chemischen Gesellschaft* a memoir on the the effect which the chemical nature and the pressure of gases exert on the development of electricity by influence machines. I had then ascertained that the quantity of electricity produced by an influence machine depends both on the nature and the pressure of the ambient gas. The continuation of these researches has become important since it appears that machines permitting the application of high pressures evolve considerably more electricity than those now in use.

Fig. 1 shows the arrangement of the machine as used in my first experiments. With reference to the arrangement of the discs, coatings and absorbers, Töpler's construction was selected, though the axle is placed vertically instead of horizontally. The axle passes air-tight through an iron plate, A, and rests at *a* in a stuffing-box, and at *b* on a point. The motion is given by means of a small drum, *c*, and a belt, *d*. The polar balls of the machine, *e* and *f*, are fixed on supports movable in all directions, fixed in the iron plate and insulated by means of vulcanite discs.

On the extreme edge of the iron plate are cast two concentric ridges, forming a deep groove, in which the glass bell, B, can be placed. The iron plate is further fitted with two cocks, *g* and a rotation indicator, *h*, for the purpose of comparative measurements.

All the space beneath the glass bell not taken up by the glass-work of the machine is filled up, as far as possible, with paraffine. If a little mercury is introduced into the groove of the plate the machine is enclosed perfectly air-tight, and yet it can be opened without difficulty.

If oil of vitriol is also placed under the bell the machine is soon surrounded by air absolutely dry and free from dust, which offers the great advantage that it always excites itself at once, and can be used even in the worst atmosphere of a laboratory.

It was found that the glasses of machines thus fitted

up do not require to be lacquered, so that all parts of the machine are perfectly proof against the action of the ozone which the machine generates when working in air. We can also, without interfering with the action of the machine, use ordinary window glass (which for the common construction is quite useless) for the preparation of the discs, as it insulates quite sufficiently in perfectly dry air.

As the paper coatings of the machine when perfectly dry cease to conduct electricity they must first be rubbed over with graphite, which renders them slightly conductive.

The arrangement just described permits of the use of various gases, but it excludes the use of high pressures. Fig. 2 shows the arrangement adopted for studying the action of the machine at different pressures.

To render measurements possible without the disturbing effect of friction in a stuffing-box, the machine was placed on the iron plate, A, under an iron bell, B, (represented in the figure as lifted off) in such a manner that the movement is effected by a small dynamo machine set in motion from without by the battery, D. It was thus possible to keep the friction of the pegs constant at varying pressures, and to effect a really perfect closure of the space under the bell. The entire room under the bell not required for the moving parts of the bell was filled up with paraffine, E. The iron bell was lined internally with a stratum of paraffine an inch in thickness, and could be pressed down upon a caoutchouc ring laid upon the plate, A, by means of four iron screws, F. The plate contained two valves, *g*, one of which is in connection with a forcing pump, G, and the other with a pressure gauge, H.

The conductors to the polar balls, *e*, *f*, were carried through the plate insulated by means of long glass tubes. For measurement, a Leyden jar, J, was used, standing in a box filled with melted paraffine. The Leyden jar was connected by wires with the supporters of the polar balls.

Besides, there was in the machine a revolution indicator, *h*, connected by wires with an element, K, and an electric bell, L, and so arranged that on the completion of every 100 rotations a contact took place and the bell sounded.

The connection between the dynamo and the influence machine was effected by drums and driving belts. To render it possible for the dynamo to be started in any position by simply closing the circuit it was constructed as a twin machine, so that two small dynamos were united in one. Their keepers were fixed on one and the same axle, and were so placed with reference to each other that the one machine was in the maximum of its action when the other was at the dead point. The arrangement described enables the influence machine under the bell to be set in motion at pleasure in different gases and under varying pressures, the revolutions of the glass discs to be counted and the quantity of electricity evolved to be measured.

FIG. 1.

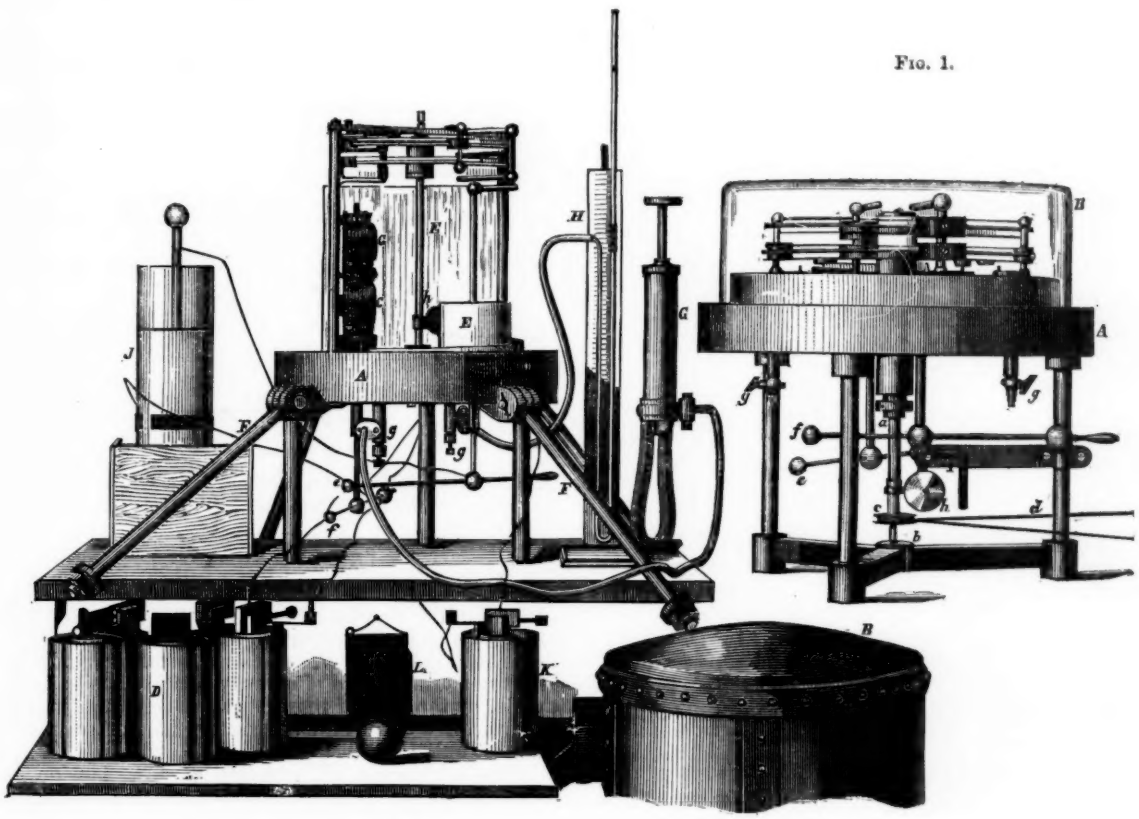


FIG. 2.

I.—*Experiments with the Influence Machine* (*fig.* 1).

The quantity of electricity was found by counting the number of discharges given by a Leyden jar for the same number of revolutions and at the same mutual distance of the polar balls.

The machine had lacquered discs. It appeared that on using hydrogen gas the collector points of the machine were not luminous in the dark, whilst in all other gases this took place very distinctly.

1. The machine gave with hydrogen at 850 rotations per minute 9 discharges, whilst in air with the same number of rotations there were 45 discharges.

2. In carbonic acid for 850 rotations there were in the mean 47 discharges, a part of the carbonic acid being at the same time converted into carbonic oxide and ozone.

3. The machine, further, when running at the rate of 400 rotations per minute in air at the normal pressure

gave 15 discharges per minute and 32 on an increased pressure of the atmosphere. On diminishing the pressure by half an atmosphere below the normal pressure the Leyden jar could not be charged at all.

An attempt to obtain larger quantities of electricity by causing the machine to run under petroleum (which is a notable electric non-conductor) proved unsuccessful. It is possible that by using sliding springs instead of the recipient points of the influence machine, a result might have been obtained. It is possible that the petroleum insulates so well that the points are unable to transfer the electricity.

II.—*Experiments with the High-pressure Influence Machine* (*fig.* 2).

The Leyden jar used for measurement had a surface of 1,236 square centimetres per coating, and the distance of the polar balls was 15 millimetres.

1. *Experiments in Atmospheric Air.*

The machine had lacquered discs.

Increase of Pressure in Atmospheres.	Number of Bunsens for turning the dynamo.	Number of rotations.	Seconds per 400 rotations.	Discharges of Leyden jar per 400 rotations.
0	5	400	54	5½ sparks
1	5	„	52	14 „
2	5	„	58	18 „
3	5	„	62	20 „
4	5	„	72	23 „
5	6	„	68	25 „
6	6	„	77	28 „
6	7	„	94	31 „
5	6	„	85	27 „
4	6	„	79	26 „
3	5	„	74	24 „
2	4	„	82	20 „
1	4	„	71	15 „
0	4	„	66	5 „

The following experiments were made with unlacquered discs :—

Series in Atmospheric Air at 15° *C.*

Over-pressure in atmospheres.	Number of Bunsens for turning dynamo.	Number of Rotations.	Time in seconds per 400 rotations.	Discharges of Leyden jar per 400 rotations.
− 206 mm.	6	...	...	Jar could not be charged.
− 380 „	6	...	...	
756 „	5	400	74	17 sparks
+ 1 atmos.	5	400	95	31 „
+ 2 „	6	400	88	42 „
+ 3 „	6	400	120	46 „
2 „	6	400	98	48 „
1 „	6	400	84	34 „
0 „	6	400	58	14 „

Series in Hydrogen.

Over-pressure in atmospheres.	Number of Bunsens for turning dynamo.	Number of rotations.	Time in seconds per 400 rotations.	Discharge of Leyden jar per 400 rotations.
0	5	400	63	6 sparks.
+ 1	5	400	75	18 „
2	5	400	83	27 „
3	5	400	92	34 „
3¾	6	400	84	34 „
3½	6	400	86	36 „
3	6	400	84	33 „
2	6	400	72	27 „
1	6	400	68	18 „
0	6	400	58	8 „
− ¼	6	No charge	was effect	ed

Series in Carbonic Acid.

Over-pressure in atmospheres.	Number of Bunsens for turning dynamo.	Number of rotations.	Time in seconds per 400 rotations.	Discharges of Leyden jar per 400 rotations.
0	5	400	59	8 sparks.
1	5	400	96	35 „
2	6	400	101	47 „
2¾*	6	400	204	48 „
2	6	400	96	48 „
2	6	400	96	44 „
1	6	400	76	32 „
0	6	400	42	8 „

These experiments show that the chemical nature of gases exerts on the one hand an influence on the development of electricity by the influence machine, whilst on the other there ensues with increasing pressure an enormous increase in the quantities of electricity produced.

For utilising the electricity produced by influence machines an arrangement like that in fig. 1 is suitable, but with the difference that instead of a glass bell an iron cap is used, which may be fixed down air tight with strong screws.

The above researches have been made with a Leyden jar—a rough measuring instrument—in order to obtain an insight into the total phenomena. The pure electric determinations of the dielectric constants of the gases at high pressures must be reserved for future investigations.

Oskar Leuner, mechanician to the Dresden Polytechnicum, has made the entire apparatus in a most satisfactory manner.—*Annalen der Physik und Chemie.*

THE ZIPERNOWSKI-DÉRI SYSTEM OF DISTRIBUTING ELECTRICITY.

[A COMMUNICATION.]

FOR the illumination of towns, as also generally in the case of the electric current having to be distributed over long distances, the so-called secondary inductors, or transformers, are singularly adapted, as it is possible, by the aid of these apparatus, to distribute the current in a cheap and satisfactory manner over great, almost unlimited distances.

The conversion of currents of low tension into currents of high tension, has been effected for years by means of Ruhmkorff's apparatus; but, for general lighting purposes, the use of currents of high tension is not desirable, and electricians have, for a considerable time, occupied themselves with the solution of the reverse problem.

One, M. Gaulard, succeeded in constructing the apparatus known under the name of the secondary generator of Gaulard and Gibbs. Experiments made on a large scale have demonstrated the usefulness of Gaulard's apparatus for the conversion of the currents; but the inventor did not succeed in combining with his transformer a system of distribution of electrical energy which would meet the requirements of a universal system of illumination and of other industrial purposes. His system does not fulfil the fundamental conditions of properly arranged central stations. These conditions are that, in the first place, the increase or decrease of the consumption of energy should always be proportional to the demand; and, secondly, that the action of the lamps and the apparatus should in no way be influenced by any changes that may occur in any one circuit.

These fundamental conditions are completely ful-

* The gaseous friction at 2¾ atmospheres was so great that the dynamo could scarcely move the influence machine.

filled by a new system of distribution of the current elaborated by Messrs. Zipernowski and Déri, electricians to Messrs. Ganz & Co., of Buda-Pest. Their system is also based on the use of transformers, and the apparatus constructed by the above-mentioned electricians, in conjunction with Mr. Bláthy, differ essentially in their outward form, as well as in their internal arrangement, from those of Gaulard; their advantages are: greater yield and useful effect with the greatest possible simplicity and durability.

We will now explain in what manner these advantages were secured to the new transformers.

In order to increase the yield of induction apparatus their inductive action must be increased as much as possible. This can be effected, in the first place, by increasing the rapidity of the current pulsations, that is the changes of the direction of the current; secondly, by bringing the primary and the secondary wire as near to each other as possible; and, thirdly, by increasing the diameter of the iron core inside the coil.

The number of current reversals per second varies in the case of the alternate current dynamo machines between 100 and 300. The latter enormous rapidity of the current reversals is considerably too high, and Messrs. Ganz and Co.'s electricians have arrived at the conclusion that 120—200 reversals per second are, in all cases, amply sufficient for the conversion of the currents. A greater rapidity would not only scarcely increase the yield of the transformer, but would also render the action of the dynamo machine much more uncertain.

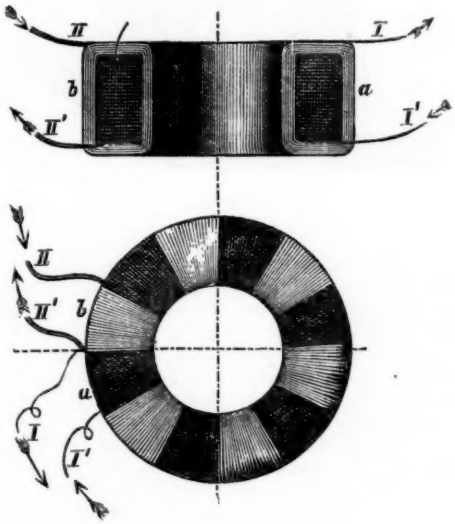


FIG. 1.

The most appropriate means of considerably increasing the yield of these instruments consists, according to the researches made by the electricians mentioned, in increasing as much as possible the action of the magnetised iron in the apparatus. The whole history of the development of the dynamo machine, which is really neither more nor less than an induction apparatus, points to the incontestable fact that iron plays an extraordinarily important part in induction; and the learned Professor Ferraris has accordingly, in his pamphlet on the generators of Gaulard and Gibbs,* with the greatest justice, characterised the suppression of the iron core, that active agent in induction, as a decided retrograde step.

If we would attempt to increase the yield of the transformers simply by bringing the primary and secondary coils nearer to each other, we should soon reach the limit beyond which further improvement is impossible! But we can, on the other hand, effect a far greater increase of the yield of induction apparatus by increasing the diameter of the iron core.

If we consider all the possible causes of the loss of energy which operate during the conversion of electric currents, we shall find that the transformer which has the greatest yielding capacity will also offer the greatest advantages with regard to the useful effect, especially if the apparatus is constructed in such a manner as to prevent any dispersion of the lines of magnetic force, and as to place all the turns of the coils through which the currents flow, as it were in a homogeneous magnetic atmosphere. The action of the induction will, in that case, be the same on each particle of the copper wire, and the chief cause of the loss of energy, the Foucault currents, will be prevented.

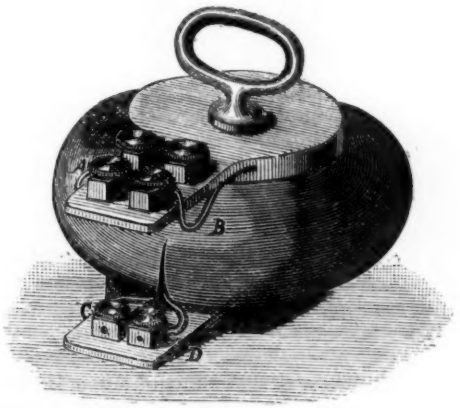


FIG. 2.

All the advantages we have just pointed out are united in the above-mentioned new transformer. Its principal forms are shown in figs. 1, 2, 3, 4, 5 and 6. The fundamental form is the ring, which is wound round in such a manner that no poles can be formed in it. The ring shown in fig. 1 consists, like that of Gramme, of a bundle of iron wires which is surrounded by the primary and the secondary coils. In the case of the ring, represented in figs. 2 and 3, iron and copper have changed places; fig. 2 is a perspective

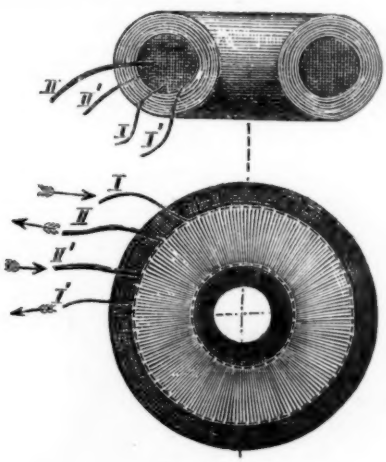


FIG. 3.

view of the new apparatus, and fig. 3 shows it in section and plan. The core consists of insulated copper wires which form two or more spirals, these are formed into a ring with circular or any other section, as required. They are then wound round with an insulating covering consisting of linen soaked in varnish, and finally wound closely round with thin insulated iron wires. The electric current in the copper wires,

* Ricerche teoriche e sperimentali sul generator secondar Gaulard e Gibbs. Galileo Ferraris: Turin.

as well as the lines of magnetic force in the iron wires, circulate in such a manner that both circuits form planes perpendicular to each other. The iron wires form to a certain extent a protecting covering for the copper wires, whose ends pass through a gap in that covering. The iron wires are either covered with cotton or coated with varnish.

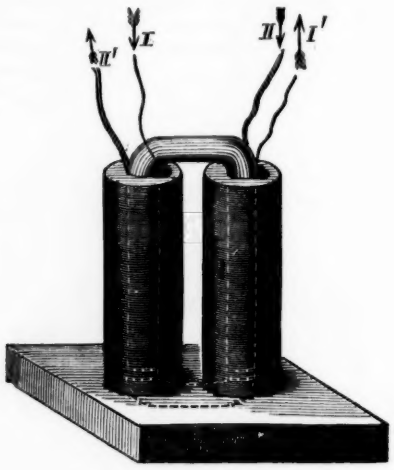


FIG. 4.

As the directions of the lines of force in the iron not only suffer no interruption but always form the shortest lines, an active circulation will take place first in one and then in the opposite sense, in accordance with the change of the direction of the inducing current in the copper wires. Each particle of the copper conductor is surrounded by an equal number of iron wires, and, consequently, also by an equal number of lines of force, that is to say, if we regard the distribution with respect to space and not to cross-section. The extremely powerful action of such electro-magnets is evident. Such an apparatus is a perfect system of equilibrium for the electrical and magnetic reversing action; and the transformation is effected with great simplicity and regularity by the induction brought into action by comparatively small masses.

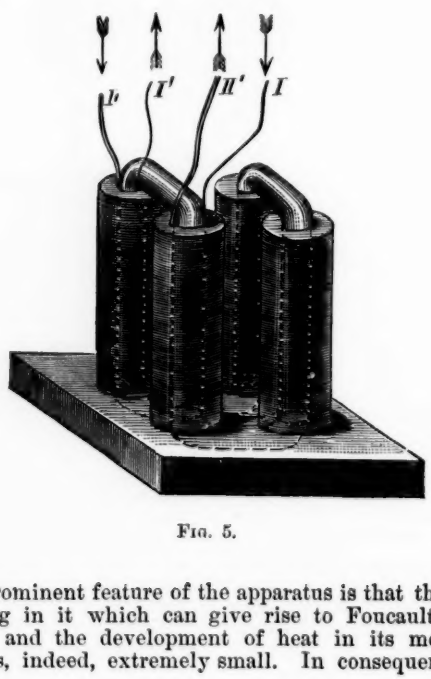


FIG. 5.

A prominent feature of the apparatus is that there is nothing in it which can give rise to Foucault currents; and the development of heat in its metallic parts is, indeed, extremely small. In consequence of the arrangement of the active iron a comparatively small quantity of current is requisite to magnetise the masses of iron. From 1 to 2 per cent. of the electrical energy is generally sufficient for that purpose, whilst the consumption of energy by the spirals amount to only $\frac{1}{2}$—1 per cent. of the total yield.

Different modifications of this transformer are represented in figs. 4, 5 and 6. In all those forms the same fundamental principle obtains; that is to say, that the copper conductors are completely surrounded by iron, and that the latter is so arranged that the lines of force form circles in planes which are perpendicular to the copper conductors; whilst currents which might be set up in a direction parallel to the copper conductors can have no access to the iron.

The columns in figs. 4 and 5, as well as the box-shaped apparatus in fig. 6, consist of sheets of iron which are insulated from one another either by a coating of varnish or by sheets of paper; they are piled up in such a way that the protruding insulated copper wires are perpendicular to their surfaces.

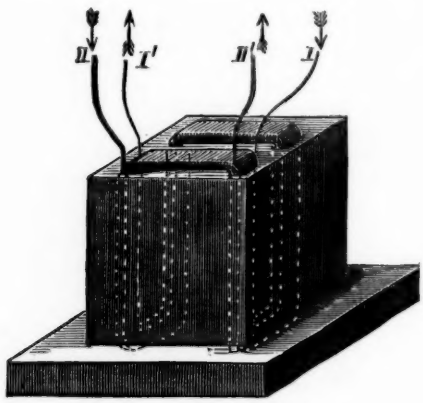


FIG. 6.

Let us now consider the action of the current reversals in the transformer, and study the connection between the different phenomena, also in the case of variable activity of the apparatus, having especial regard to the circumstance that the resistance of the wire spirals is extremely small, and, even with the greatest allowable current strength, scarcely exceeds $\frac{1}{100}$th of the external resistance.

Let E_1 be the difference of potential between the terminals of the transformer when the primary current, i_1, enters; e_1 the opposing E.M.F. of the primary spirals; E_2 the difference of potential between the terminals of the secondary current, i_2; e_2 the E.M.F. of the secondary spirals during the induction; R the resistance of the external secondary circuit (the resistance of the lamps, &c.); and S_1 and S_2 the actual resistances of both spirals respectively. There is in both circuits

$$E_1 - e_1 - S_1 i_1 = 0 \text{ and } e_2 - (R + S_2) i_2 = 0$$

But as the values of S_1 and of S_2 are in all cases extremely small, the products $S_1 i_1$ and $S_2 i_2$ may be neglected, and we have then the equations

$$E_1 = e_1 \quad \text{and} \quad e_2 = R\, i_2$$

which are for good apparatus sufficiently correct.

As further, in the case of the present transformers, the inductive action is—in consequence of their above-mentioned properties—exactly the same in all spiral windings, if we represent the E.M.F. of a single turn by E, and the number of the primary and that of the secondary turns by n_1 and n_2 respectively, we shall have:

$$e_1 = n_1 E \quad \text{and} \quad e_2 = n_2 E$$

therefore

$$e_1 = \frac{n_2}{n_1} e_2$$

and this, combined with the above equations, gives

$$E_1 = \frac{n_2}{n_1} \cdot R\, i_2$$

in which $\frac{n_2}{n_1}$ is a constant factor, which depends on the construction of the apparatus and may also be called the *coefficient of conversion* of the transformer.

From the last equations we derive the following deductions:

1. *The difference of potential between the primary terminals is always proportional to the difference of potential between the secondary terminals, or:*

2. *The proportions between the tensions at the primary and the secondary terminals is constant and equal to the so-called coefficient of conversion of the transformer.*

(*To be continued.*)

A TELESCOPIC PENDANT ELECTROLIER.

THIS apparatus is constructed of two tubes, H and K, (fig. 1) sliding one within the other through a stuffing box, J, similar to a cork slide gas pendant. These tubes, in connection with the ceiling plate, A, form one electrode, the other being formed by the inverted cup, B (which is insulated from A), the ball, C, and the rod, I, which slides in an inner tube, L.

FIG. 1.

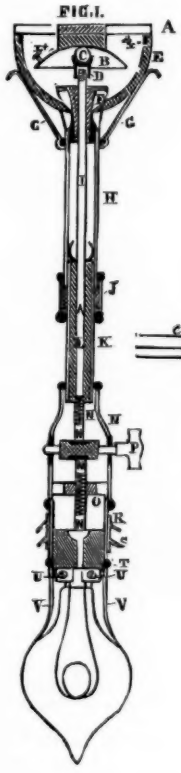
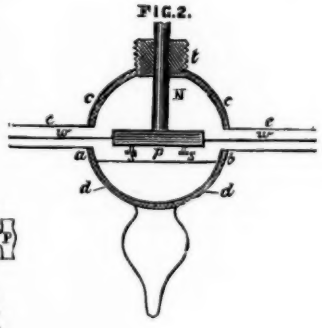


FIG. 2.



The pendant swings and rotates in a sort of cup and ball joint at F, the contact between the outer tube and the cup, E, being assisted by the springs, G, G, and that between the inner rod, I, and the plate, B, by the spiral spring, D, under the cup and ball, C.

A switch at P does away with the trouble and cost of running separate leads to some other portion of the room as is usually done. A ceiling plate can be fixed in as many rooms as may be required, and the wires attached, and then the pendant can be moved from room to room as required.

The attachment, fig. 2, enables as many lights as necessary to be added or taken away by any unskilled person in a few seconds, and though those already made are capable of carrying six lamps taking one ampère each, still the apparatus does not look too heavy or cumbersome for a single light pendant.

A reliable holder is supplied for plain lamps, but several of the centre contact forms of capped lamps will fit the pendant, and it could be made to any desired pattern.

There are no cords or pulleys to get out of order, and a short circuit is absolutely impossible. The drawing is, of course, only to show the interior parts, but they can be made as ornamental as desired. It appears likely to become a prominent feature in ship lighting as it seems particularly adapted to that service.

The pendant has been devised by Mr. Grundy, the electrician to the Royal Courts of Justice, in connection with his friend Mr. Ready. A neat and practical form of lamp holder invented by the former gentleman was illustrated in the REVIEW for March 28th, 1885.

DIRECTIONS FOR ERECTING AND MAINTAINING STORAGE BATTERIES.

IN a paper giving a description of a large secondary battery plant for general commercial distribution, read before the American Institute of Electrical Engineers, on May 20th, 1885, Mr. E. P. Roberts, M.E., general manager of the Brush-Swan Electric Light Company, of Cheyenne, Wy., gives the following directions for erecting and maintaining storage batteries:—

Directions for Erecting and Maintaining Storage Batteries.

A. CAREFUL INSULATION.

1st. Battery as a whole well insulated from the earth.

2nd. Each cell insulated from all others, excepting, of course, through the proper channel for the passage of current.

3rd. The positive and negative in each cell to be insulated from each other except through the liquid. No connection by moisture on the upper edge of the containing box.

B. REGULAR CHARGE AND DISCHARGE.

1st. Fill the battery every day.

2nd. Discharge the battery every day.

3rd. Never over-charge.

4th. Do not exhaust completely.

C. DO NOT EXPECT BATTERIES TO TAKE CARE OF THEMSELVES.

1st. Test electromotive force of each once a week with a voltmeter.

2nd. Test each cell with an acidometer once a month.

3rd. Each day see that each cell in each battery fills in the same time.

4th. Keep plates covered with liquid.

5th. Examine all connections frequently.

D. Keep extra cells complete and charged, with which to replace defective ones. Do not put uncharged plate or cell in battery in regular use.

E. Do not "box in" batteries. Give free circulation of air.

F. Keep all connections, switches, &c., as far as possible away from batteries.

G. Study the cause producing a new effect, and attend to details.

REMARKS.

After considerable experience with storage batteries, my conclusion is that they have been both praised and belittled too much. That the service can be good is certain; but that for a closely settled district they are preferable to dynamos is not, according to my experience, correct.

Experience teaches the manufacturers many points

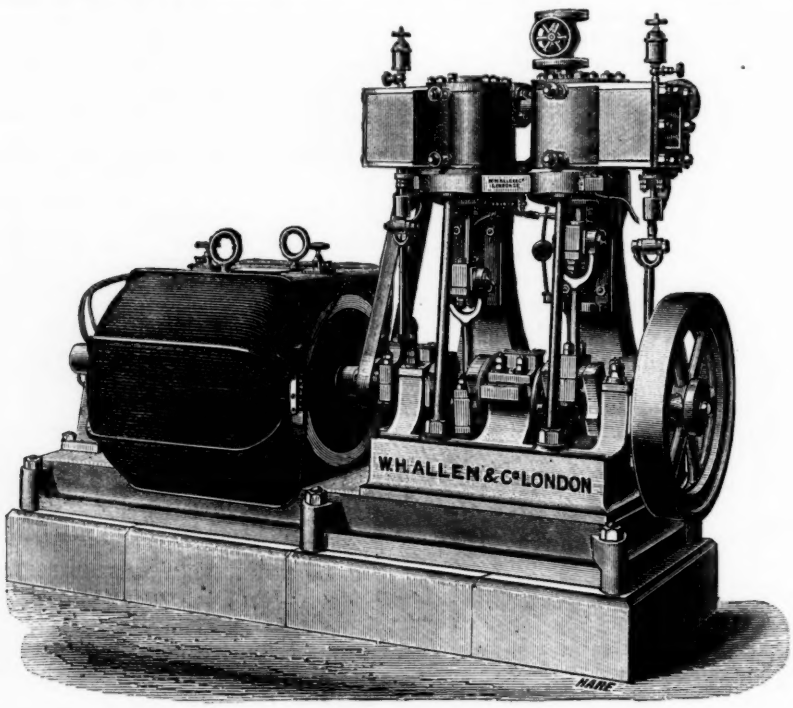
in design and formation which greatly increase the reliability of secondary batteries. Experience in handling them teaches men many little matters which greatly assist in keeping the batteries in good condition.

My plan for our new station about to be erected will show, more forcibly than a lengthy disquisition, my ideas respecting secondary batteries in connection with stations for the distribution of electrical energy.

A building is to be erected near the business portion of the city, from which our arc lights will be supplied, and in which also will be placed dynamos for running the incandescent lights in the business district. Batteries will be used in portions distant from the station. These will be charged from 3 a.m. until 7 a.m. with a 15 ampère current. At the station will be several large batteries, which will be used for day lighting or in case of a breakdown.

COMBINED "ALLEN" ENGINE AND "KAPP" DYNAMO.

THE engine is of Messrs. Allen & Co.'s well known type, many such being in use on board ship for working centrifugal circulating pumps and large fans direct.



Some of these engines have to work without once stopping for six weeks, and the wearing surfaces are very large, and special lubricating arrangements are provided by which a run for a lengthened period is rendered possible. The engine has two cylinders 6½ inches diameter by 5 inches stroke, and the cranks are set at opposite centres, in order to obtain a perfect balance of the moving parts.

The arrangement shown in the illustration is principally intended for ship lighting. Hitherto dynamos for that purpose have been driven by rotary engines, or some kind of high-speed engine, the parts of which were more or less inaccessible, and the speeds employed varied between 450 and 1,000 revolutions. By the introduction of the "Kapp" dynamo it has become possible to reduce the speed between the limits of 300 and 340 revolutions (according to size), and to employ an ordinary engine, the parts of which are all easily accessible, and the construction of which is perfectly well known to the sea-going engineer.

The field magnets of the dynamo are of such shape as to occupy little space and afford a circuit of very low magnetic resistance. The armature is a Gramme ring, having an exceptionally heavy core composed of soft charcoal iron wire. This core is supported on a perforated gun metal cylinder firmly keyed to the spindle, and having at stated intervals radial projections or driving horns, the tips of which are insulated by fibre ferrules, and enter between the external wires, thus transmitting the driving force in a positive and mechanical way to the coils which do the work. The perforations of the cylinder serve to admit air into the core, which escapes between the wires on the circumference of the armature. The dynamo we illustrate gives 110 volts at its terminals and a current of 150 ampères, the speed being 340 revolutions a minute, and the total weight of engine and machine is 3 tons. It is at work in the electric light shed at the Inventions Exhibition.

SUBMARINE TELEGRAPH CABLES BILL.

THE MARQUIS OF TWEEDDALE, in the House of Lords on the 23rd ult., presented petitions from the Anglo-American Telegraph Company, Direct United States Company, Eastern Company, Eastern and South African Company, Eastern Extension Company, Brazilian Submarine Company, Western Brazilian Company, Direct Spanish Company, West India and Panama Company, and Telegraph Construction and Maintenance Company against the Submarine Telegraph Cables Bill.

On the motion to go into Committee on the Bill the same evening,

The MARQUIS OF TWEEDDALE said he wished to take that opportunity of protesting against the manner in which the convention dealing with submarine telegraph cables had been conducted. The property affected by the convention consisted of 110,000 miles of telegraph cable, of which 98,000 miles belonged to private individuals or to private companies. The whole of those cables had been laid down at different times by English hands, and were for the greater part maintained, kept in order, and repaired by English hands. The value of the property in submarine cables owned by private individuals or companies was estimated at £34,000,000, and the owners of that property were for the greater part inhabitants of the United Kingdom. That was the nature of the property to which the convention applied, and for the protection of which the convention was held in March, 1884. The convention was composed of the representatives of 26 Powers, including the European Powers, two Asiatic Powers—viz., the Shah of Persia and the Indian Government—the United States, and some eight or ten small Governments in South America. The only feature common to all those representatives was their com-

plete ignorance of everything connected with submarine telegraphy. He did not believe there was one person at that convention who had any knowledge, theoretically or practically, of the laying or maintenance of submarine cables. It was naturally to be expected that the convention would communicate in some way with the owners of this valuable property. So far from doing so they legislated for it in complete ignorance of the subject, and without inviting the owners or other persons capable of doing so to give them information. The result, as might be anticipated, was that the Bill carrying out the deliberations of the convention contained clauses so objectionable that the owners of this valuable property, almost to a man, had petitioned that this Bill, designed for their protection, should not become law. They alleged that so far from the Bill being calculated to protect them, it was eminently calculated to injure and in some cases to ruin them. The best evidence he could give that the objections to the Bill were not exaggerated was afforded by the amendments which the noble duke who had charge of the Bill had placed upon the paper. In one case the amendment proposed by the noble duke was very considerable, and in another it entirely wiped out one of the articles of the convention. He ventured to think, however, that the amendments he had placed on the paper were preferable to those of the noble duke; at any rate, the owners of the telegraph cables preferred them. He had risen to record this protest, because he thought it intolerable that a large and valuable property like this should be dealt with, as this had been, without any communication with those for whose benefit the convention was ostensibly held.

The House then went into Committee on the Bill.

Clause 1 was agreed to.

In Clause 2 an amendment proposed by the Marquis of Tweeddale was adopted.

On Clause 3,

The DUKE OF RICHMOND AND GORDON said the amendment which he had to move had been adopted by him in consequence of representations made by the noble marquis and other gentlemen interested in the subject. It was pointed out by them that the clause affected telegraph companies injuriously and rendered them liable to be punished by fines and imprisonment if in their exercise of their duty to repair their own cables they injured those of somebody else. It might very well happen that in repairing their cable a company might unintentionally damage the cable of another. To meet this difficulty he now moved to amend the clause by providing that no person should be deemed to have acted wilfully who, in order to repair one submarine cable, should be unavoidably compelled to injure another submarine cable. The provision was not, however, to exempt the person injuring the cable of some one else from liability for the cost of repairing it.

The MARQUIS OF TWEEDDALE said that he entirely agreed with the principle of the amendment, though it did not, in his opinion, afford sufficient protection to those for whom it was intended. He objected to the use of the ambiguous word "unavoidable." It would be almost impossible to say whether any particular act done by the captain of a ship in mid-Atlantic in the repair of a cable was, under the circumstances of the case, unavoidable or not. It should be sufficient that everything was done in reason to prevent injury to other cables. He would suggest an amendment to the effect that punishment should not be inflicted when sufficient and reasonable precautions had been taken to prevent injury being done to another cable.

LORD BRAMWELL could not help thinking that this was a very dangerous piece of legislation. It appeared to him, however, that the amendment of the noble duke was an improvement on the original clause, and that the amendment of the noble marquis was an improvement on that of the noble duke; but he himself intended to suggest a third amendment (a laugh) to the effect that this section should not extend to any case where in a *bonâ fide* attempt to repair a submarine cable injury had been caused to another cable or the same had been broken, but that the section should not apply so as to prevent a civil remedy.

The DUKE OF RICHMOND AND GORDON remarked that his amendment was substantially the same as that proposed by the noble marquis. The noble marquis had referred to the difficulty of mending a cable in the Atlantic, but the amendment he proposed to insert in the Bill had reference only to the 100 fathom limit, and, consequently, what the noble marquis said was not much to the purpose. They had all the same object in view, and that was not to subject persons to what would certainly be an injury in the execution of what was their legitimate duty. There were three propositions before the Committee—his own, that of the noble marquis, and that of the noble and learned lord. He liked the third better than the second, and it was possible the second might be better than his own. He would suggest that that of the noble and learned lord should be printed, and that the matter should be left open to the report, which he hoped might be taken on Friday.

The LORD CHANCELLOR suggested that there were some ambiguities in the clause of the noble and learned lord, which he might correct in putting it on the paper. The words "*bonâ fide*" and "reasonable care" involved the question which would have to be determined by a jury.

The clause was ordered to stand part of the Bill without amendments.

The DUKE OF RICHMOND AND GORDON proposed to insert after clause 3 a clause to meet objections which had been raised that the measure went far beyond what was reasonable. It was said that it would be very difficult indeed in mid-ocean to take up a cable, especially in places where they were in close proximity. He therefore proposed that Article 4 of the schedule should only apply to a depth of water not exceeding 100 fathoms, a limit which was well defined in all charts. There was no difficulty in dealing with cables within that depth; it was easy to take them up and repair them. He added to the clause a proviso preserving any right or remedy possessed independently of the Convention or of the Act.

The MARQUIS OF TWEEDDALE accepted the amendment, and said he was obliged to the noble duke for the manner in which he had endeavoured to meet the wishes of those concerned.

The EARL OF CAMPERDOWN asked whether the limitation in the amendment was consistent with the convention, which applied to all cables, and for which the contracting parties undertook to ask the sanction of their Legislatures.

The DUKE OF RICHMOND AND GORDON said that Parliament could not be compelled to carry out the whole convention.

The EARL OF CAMPERDOWN said he was afraid we were establishing a system of punishment for British subjects which would not be enforced by foreign nations against their own subjects engaged in these operations, which would be undertaken when we were neither at peace nor at war, but between the two.

The clause was agreed to, and clauses 4 to 9 were added to the Bill.

The MARQUIS OF TWEEDDALE said the object of article 3 of the convention was to secure in future that a cable should be laid in such a manner that it would not cause any injury to any other cable, and he wished to provide that in future when a concession was given, before it became valid it should be treated as a provisional order—in other words, that the concession should remain for a certain number of days so that it might be examined, discussed, and, if necessary, objected to. At present, there was no machinery whatever for ascertaining the nature of the concession which might be granted by the Board of Trade or the Post Office.

The DUKE OF RICHMOND thought the effect of this amendment would be very much in favour of existing companies, because it would be very difficult for new companies to become established as means might be taken during the time application was being made to endeavour to buy up the new company.

LORD BRAMWELL supported the amendment.

The MARQUIS OF TWEEDDALE said he had had no communication with any of the companies on this subject, and there was no intention to stop concessions.

The amendment was withdrawn, and the Bill passed through Committee.

The remaining clauses were agreed to, and the Bill, as amended, was reported to the House.

On Friday, on the Order of the Day for the consideration of the report of amendments on this Bill,

The DUKE OF RICHMOND AND GORDON moved an amendment exempting from the penalties imposed by the Bill for injuring telegraph cables persons who accidentally injured such cables in attempting to repair other telegraph cables.

The amendment was agreed to.

The EARL OF CAMPERDOWN wished to ask a question with regard to a matter of some importance. This Bill was brought in for the purpose of making regulations to enable the English Government to carry out the terms of the convention, but it appeared only to carry out the terms of that convention to a limited extent, and to make, in fact, a new convention. Was it within the power of the Government to bring in a Bill of that character?

The DUKE OF RICHMOND AND GORDON replied that all the Government had undertaken to do was to submit a Bill on the subject to Parliament. That Bill would be dealt with according to the wisdom of Parliament. The Government could not undertake to require Parliament to carry out the convention in its entirety.

The MARQUIS OF SALISBURY said that it was open for the convention to be modified by future negotiations, or a Bill might be brought in covering those parts of the convention not now covered.

The EARL OF CAMPERDOWN observed that in consequence of our not carrying out our obligations under the convention, other Governments might refuse to carry out theirs.

The report of amendments was then adopted.

IMPORTANT TELEPHONE PATENT CASE.

(*Continued from page* 79.)

(*Specially reported for the* ELECTRICAL REVIEW.)

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

(*Before* MR. JUSTICE NORTH.)

UNITED TELEPHONE COMPANY, LIMITED, V. BASSANO AND SLATER.

Friday, July 17th, 1885.

MR. CONRAD COOKE was recalled and his examination continued by Mr. PLUMPTRE. He proceeded to describe the experiments mentioned by Prof. Forbes.

Mr. PLUMPTRE: Did you draw any conclusion from those experiments as to the necessity of a resonant case or diaphragm?—They showed me that the microphone was capable of receiving vibrations produced by articulate speech by the direct impact of the sound waves, and therefore without necessarily the aid of any resonant device.

Mr. JUSTICE NORTH: Was this new to you?—No. The very great success was new to me. I made experiments more than a year ago of a similar character, but they were not so successful. I attribute the great success of this last experiment to the fact that I simply took the microphone out of the transmitter and placed it on the tapes.

I suppose it was affixed to something?—Only to the tapes. The carbon blocks were fastened to the tapes by sealing wax.

But how were the tapes fastened to one another?—By the same means; immediately under the microphone. My previous experiment, which was not very successful, was by simply taking one carbon pencil and supporting it in a different manner, vertically. I think the success of this other experiment was due to the fact that I employed the double microphone of the defendants' in exactly the same position that they adopt in their instrument.

As I understand, your first experiment was after the Scotch trial?—Yes. The microphone was first used in May, 1878. I was the first to whom it was shown.

Mr. PLUMPTRE: What are the characteristics of the diaphragm described in Edison's patent?—I take it that he attached great importance to his opinion that it must be of a non-resonant character.

Mr. JUSTICE NORTH: I do not understand, Mr. Cooke. I am surprised to hear you say that. In what passage do you find that?—I refer to page 5, lines from 6 to 19. "The next feature requiring consideration is the character of the diaphragm in the speaking instrument. Many materials have been employed by me, such as metals, horn, vellum, celluloid, ivory, &c., but almost all of these produce a prolonged or secondary vibration from their own resonant character, hence the articulation is defective and the sound vibrations blend. After extensive experiments I find that mica is almost entirely free from any resonant action, and hence it will respond with the greatest accuracy to the sound vibrations, and being of a laminated character can be employed of any desired thickness, and when secured at its edges responds with the greatest accuracy to the sound vibrations and does not require to be strained; furthermore, the changes of temperature and atmospheric condition have little or no effect upon the mica diaphragm or tympan." From that I gather it should be, first, non-resonant; second, a material that can be used as a tympan; and, third, that it should not be affected by temperature or moisture.

Mr. JUSTICE NORTH: But this passage was a specific claim to mica, and that has been disclaimed now?—I am not mentioning that to give any idea that the plaintiff is making any claim to mica. I only want to show that he wanted something of a non-resonant character.

Mr. PLUMPTRE: Take a case where the diaphragm is made of wood, and tell me how far such a diaphragm would have the properties just mentioned?—I should say that wood would be one of the worst substances to choose as fulfilling those conditions, and more especially the wood, which I understand is pine or white deal, used in defendants' instrument, because in the first place it is one of the most resonant materials we have; and, secondly, it is singularly affected by moisture, or atmospheric condition I would rather say—those are the words of the patent.

Mr. JUSTICE NORTH: Would varnish make any difference?—Yes, a little; I do not think it would make any very great difference. It would make no difference to its resonant character.

But wood is a material which could be used as a tympan?—No, not well, for this reason, that it is important, for a tympan to act on a tension regulator as described in this specification, that it should be flat, in order that it may always occupy the same position as to its distance from the tension regulator in its normal position, a position of rest, and the effect of moisture, whether from the breath or from atmospheric conditions, would tend to warp or curl it, and thus destroy its adjustment with respect to the tension regulator. That is my reason for thinking that Edison excluded it from his patent.

Mr. PLUMPTRE: Do you consider, in the Ader instrument put in yesterday, that the tension regulator is within the Edison patent?—No, I do not.

Do you find that there is any form of mechanical connection made between the carbons in that tension regulator, and the slad which has been called a diaphragm?—Yes; the carbon blocks are attached to the under side.

Mr. JUSTICE NORTH: Was that of Ader after Edison's patent?—Oh, yes; long after.

Does the vibration of the wood make the blocks move sooner than the pencils would move?—It sets the whole in a tremor.

Yes; but the inertia of the pencils makes that kind of motion sometime after the block?—I should think probably it would.

That is the way variations are produced, is it not?—Yes, I think so. There are a number of phenomena; that, I think, is undoubtedly one of them.

Mr. PLUMPTRE: Now, please, take the Gower-Bell instrument. I ask you the same question as regards the diaphragm in that. Is it within Edison's patents?—I think not.

Mr. JUSTICE NORTH: These (the Ader and the Gower-Bell instruments) are practically the same?—I think they are practically the same for this purpose.

Mr. PLUMPTRE: Now please take the plate of the Theiler instrument. Upon that instrument did you give evidence at the Scotch trial?—I did.

On examining the instrument did you come to any conclusion as to whether or not there was a diaphragm there?—I did not think this (indicating) acted as a diaphragm in this instrument.

Although you were told you were wrong, you are stubborn enough still to maintain that opinion?—I think that in the Theiler instrument the whole case acts as a resonator, a sounding board, and this portion no more than the rest of the case, for the reason that whatever tympanic vibration there would be from the ferrotype disc if placed across an opening, and free to move in the manner in which ferrotype diaphragms are, I believe, always employed in other cases, would be damped and destroyed by the cork, which is of a singularly non-resonant character.

Has the instrument spoken even better when the door was open—that is to say, speaking into the back of it, taking care to connect the springs to the battery?—I came to the conclusion, as I believe I stated in evidence, that the instrument would work better if the ferrotype and cork were removed, leaving an open space, and the microphone were subjected to the direct impact of the sound waves proceeding from the mouth. I think that has been justified to a great extent by the experiments which Prof. Forbes described in connection with the putty mouth-piece.

I think the substantial point there between the parties was whether or not there was a diaphragm?

Mr. JUSTICE NORTH: As I understand, it was whether this (the Theiler instrument) was an infringement. I have seen the judgment.

Mr. PLUMPTRE: I will put it this way: Did you hear the remark made by the Lord Advocate as to doing away with the diaphragm? The judge said, If you do away with the diaphragm the instrument is without the patent?—I am under the impression that I did, but whether I derived it direct or not I cannot say.

We will pass from the diaphragm and speak of the tension regulator. What, in your opinion, are the nature and characteristics of the tension regulators described by Edison?—First of all they must be non-homogeneous in structure; they must be more or less compressible; they must have a certain amount of elasticity; they must be semi-conducting; they must vary their conductivity under variations of density produced by compression. Looking in the specification to see what he means by a tension regulator, I find he describes them in different language, but all depending upon their action, to a greater or less degree, upon the principle of varying their specific conductivity under variations of density. He speaks of "small bunches, or tufts, or discs of semi-conducting elastic fibre, such as particles of silk and an intermediate conducting, or semi-conducting material; this device I call an electric tension regulator." He describes the action very accurately. "It is more or less compressed, according to the vibrations of the diaphragm or tympan, and the electric current rises in tension as it is compressed or lessens as the fibre expands." The discs in that case, if they are to be compressed together to produce greater intimacy of contact, must have more or less elasticity, otherwise they would not spread out. But I cannot understand how that device can be constructed, for there is nothing to show of what the disc is to be made, or whether it is to be a conductor or an insulator. It is difficult to imagine how the current is conveyed into the powdered carbon which is laid over it.

Mr. ASTON remarked that there had been no suggestion of anything of this kind in the case until now.

The WITNESS, continuing, said: I think in all cases the tension regulators are mixtures of two substances—one conducting and the other non-conducting. It may be silk and metal, silk and plumbago, plumbago or other forms of carbon in a state of minute division or powder, and therefore mixed with air, and therefore more or less elastic. And they are all compound substances, which by being pressed upon or relieved from pressure by a vibrating tympan or diaphragm increase or decrease their conductivity, and, therefore, produce a rise or fall of the electric tension in the line.

Mr. PLUMPTRE: If hard carbon were substituted in an Edison transmitter do you think it would act in the manner specified by him?—No, I feel sure it would not. In the first instance, because it is not sensibly compressible; it does not vary electrical resistance or conductivity under variations of mechanical compression.

Can you tell me whether, in your opinion, the action described here, by which the resistance is varied, whether that is in the nature of what has been called microphonic?—I do not understand that.

Whether Edison's mode of varying the resistance of the line is the same as what has been called the microphonic manner?—No; I think not. I think there is nothing in this specification that would lead anybody to discover the principle of, or to construct a microphone; and by the word microphone I do not mean only that instrument which has been alluded to for hearing the tramp of a fly, but I mean, also, all those forms of microphones which Prof. Hughes——

Mr. JUSTICE NORTH: Never mind that. You say it is not microphonic?—Yes; because every form in this specification depends upon the principle of varying its electric conductivity under variations of compression or density. Although that action may enter to a minute degree into the phenomena of the microphone, the action of the microphone cannot, in my opinion, be attributed to that, when there are other phenomena which can to a much larger degree account for its action.

Mr. JUSTICE NORTH: Namely? Tell me what they are.—The tumbling over of the movable pencil from one or more points in

the socket having a certain conductivity to other points of greater or less conductivity; that is to say, the resistance of the joint—the point where one pencil rests upon the other—is continually varying by every change of position in which the pencil rests upon its sockets, the carbons of which microphones are constructed being full of minute specks of different degress of hardness. I have no doubt that that very largely, perhaps to the largest extent, is the explanation of the action of a microphone.

You say Edison's method of varying is not what may be called microphonic because the other things account for its action. Bits of silica do not account for it, do they?—Yes, my lord, because they decrease the conductivity when they come between the carbons.

Then they destroy it; they break the circuit?—There may be other contacts. That would be so if there were no other points of contact. In the instrument of the defendants they have two carbons in order to make sure that that shall not take place. In the Ader and in the Gower-Bell the multiplicity of those carbon pencils is to get over that and to always have contact. The original instrument of Prof. Hughes acted perfectly well the first time it was used. It was not a mere magnifier of sound. It was a really good transmitter.

Mr. PLUMPTRE: Now as regards the compressibility of carbon. Is carbon, in your opinion, appreciably compressible?—No.

Have you performed any experiments to test the compressibility of carbon?—I made some experiments to test, not its mechanical compressibility, but the influence of compressibility on its conductivity, being a device which would compress it if it were compressible. It is claimed for all these tension regulators, and especially for plumbago, which, of course, is a form of carbon, that a tension regulator, fibre or plumbago, increases and decreases its resistance enormously under slight changes of pressure. To test the question whether hard carbon has the same properties as claimed here, I made a very careful test of that very question. I took a piece of carbon about three inches long, and having electrotyped the ends with copper and wrapped wire round the two ends of that copper, I connected it with an instrument known as a Wheatstone's bridge, for balancing and measuring the resistance and placing it in a vice, there being, of course, no contact between the vice and the wires, and, squeezing, I could get no sort of movement in the galvanometer until the whole thing gave way. I therefore came to the conclusion that whatever may be said whether or not it is true about plumbago, that it decreases and increases the resistance enormously under a slight change of pressure, it certainly cannot be said of hard carbon that it increases or decreases its resistance even minutely under very enormous changes of pressure.

Mr. PLUMPTRE: In your opinion is hard carbon a semi-conductor or a good conductor?—A good conductor.

I don't know whether you can give me reasons why you say that?—It is entirely a question of degree. All the metals are always considered good conductors, although they vary considerably among one another, and carbon comes so very near to the metals, as shown in the scale of conductivities, as compared with substances which are lower than itself in that scale, the gap between carbon and the next lower being over a million times greater than that between carbon and the very best conductors.

Mr. JUSTICE NORTH: Does that remark apply to the diamond?—Diamond is an extremely hard carbon. No; that must be excluded. Hard carbon has a very specific meaning in electrical matters. Diamond is a pure carbon, and is hard.

By hard carbon you mean pencils, or something of that kind—pencils of hard carbon for electrical purposes?—Yes.

Mr. PLUMPTRE: In your opinion, would the Edison transmitter, with an Edison tension regulator, as described by him, act without a diaphragm as described by him?—Certainly not. I am unhesitatingly of opinion that there is not one of Edison's tension regulators that could possibly act without a diaphragm.

Cross-Examined by Mr. ASTON: I should like to ask you one question about carbon being appreciably compressible. You were not always of that opinion?—From the time I tried that experiment I have been.

When you speak of carbons in telephone matters, you mean hard carbons?—Yes.

Then you were asked when you were before Lord M'Laren whether you knew whether carbon was elastic or not? You meant by that hard carbon?—Yes.

Mr. JUSTICE NORTH: Do you remember being asked that question?—I do not, but probably I was.

Mr. ASTON: Has it not a certain amount of elasticity?—Yes, it has.

Is it not compressible?—Yes, it is.

When you squeeze it you compress it?—Yes, I think so, as far as I can judge.

When you move carbon that has weight suddenly, there is a certain amount of squeeze put upon the surface, is there not?—Yes. There must be a certain amount of compression by any movement, but not appreciable.

That is to say, if you have a pencil of carbon whose ends rest in holes between two blocks, and you move the blocks with respect to the pencils, or the pencils with respect to the blocks, you give squeeze?—I should say there would be a certain amount of compression at that point of contact.

And that is what you may fairly represent by a species of squeeze between the two surfaces at that point?—I should not say a squeeze unless you have something to back it up on the other side.

But the weight, you know?—Well, if you take the weight as the opposite, I should say there would be. There is a pressure of the one resting upon the other.

If you get that pressure you get a greater extent of surface contact between the two carbons that are at that moment in surface contact?—Yes, I think you would. It is exceedingly difficult to understand it in that way. There are two rough surfaces together, you get a number of points of contact.

I only introduced the squeeze in order that to a certain extent I might refresh your recollection; and now I will adopt the term you made use of. Is it not true, when you have two carbon pencils resting in holes in a block, and the pencil is moved with reference to the block, and the block with reference to the pencils, you have variations of the pressure at the points of contact?—Yes, I think so.

And those variations of pressure produce greater or less intimacy of surface contact?—No, I do not understand that.

You said that there were certain points, you know, and you have some of them in contact and others not, and the more points in contact the greater contact you had?—I should not understand it as intimacy of contact. I do not understand the term intimacy of contact.

At all events, greater area of contact?—Yes, you would.

Then if you get greater area of contact, do you not lessen the resistance to the passage of the electric current?—Not necessarily, for this reason, that it is possible for an increase of the area of surface in contact to introduce a larger number of insulating points.

Is it not a fact that if you take two carbon pencils together, and you press them together, that you get a freer passage of electricity through the pencils?—Yes, I think so. If they are pointed pencils, then there comes the crushing.

Have you any doubt but what a tension regulator varies the resistance in a closed circuit?—No; I am sure it does.

And is it not true that in order to convert articulate sounds which produce sound waves at the transmitter end into articulate sounds resulting from sound waves at the receiver end, you must have variations in the electricity passing along the line wire, and the variations in the electric current are, to use your own terms, sympathetic, are they not, with the variations of the sound waves?—I should say they are the result of the sympathetic mechanical transmission to the diaphragm. I should not call the sounds themselves sympathetic.

They are synchronous, at all events?—I should say so.

Is it not a fact that a microphone does act so as to reproduce synchronously variations in the electric current as compared with variations in the sound waves from the voice?—Yes.

Now, you say that in your opinion that may be due to something else than compression of the carbon of the microphone?—Yes.

But, at all events, if there be compression, that will account for all the phenomena you see?—I do not know. I do not think so.

You don't agree with what you have heard, that compression would account for it?—I think the loudness is due to something else.

Is it not a fact that in your experiments you found that the loudness was increased when you put your microphone upon what you call a sounding board?—The sensitiveness would be increased.

Loudness as well; it was clearer—you could hear it better?—No; I think not always.

But very often you could hear it better?—If you mean the magnification of sound, I should say yes; but if you say articulation of speech, I should say no.

Mr. JUSTICE NORTH: What do you say about the effect of the sounding board on clearness?—I think it diminishes clearness.

Mr. ASTON: Now is not the action of the sounding board a mechanical action to give vibration to the carbon pencils or blocks of the microphone?—Yes.

Does not that result in a relative motion?—Yes.

And does that not result in compression to a certain degree?—Yes.

That results in increased area of contact?—I would rather not say increased area of contact. I mean variation of the area of contact. There is nothing to show whether it increases or diminishes.

And variation of resistance?—Variation of resistance.

Is not all that exactly true of the Edison transmitter when used with the diaphragms which he describes?—No, I think not.

No! Then I will take you step by step. Is not the function of the Edison diaphragm to take up the vibrations of the sound waves? It intercepts and takes them up?—Yes.

Are there not consequent thereon vibrations in the diaphragm?—Yes.

Do not those vibrations of the diaphragm act mechanically upon the tension regulator of every form used by Edison?—Yes, I believe so.

In every case Edison has his tension regulator in closed circuit?—Yes, I think he has. I am not quite sure whether fig. 10 is in closed circuit or not.

Is not the result upon the tension regulator variation of area of contact?—I do not know that that applies to all of them.

The major part of them?—No, I do not think it is.

Are you really sure?—If I understand your question, I think my answer is correct.

We will take the case where the surface contact is made by a plumbago surface, covered with a coating of plumbago, pressing against another surface coated with plumbago?—In that case I think it is so.

Mr. JUSTICE NORTH: Do I understand you to say that the

action of a tension regulator is not in all cases variation of surface?—I think I may go further, and say it is rather the exception.

Mr. ASTON: In what case do you say there is no variation of surface contact within the regulator itself?—I do not think it would be a correct explanation of the action of these fibrous, compressible regulators to say that they act by variation of surface contact—except in a remote degree.

Your exception proves the rule, in a remote degree; in that case, then, there is surface contact, is there not?—Do you mean the minute particles of dust?

I mean variation of extent of surface contact. If you do not understand that English expression then, of course, I will try to put it in another form.—If you mean the surface of those little specks of powder——

I mean there is greater extent of surface in contact at one time than there is at another when the fibre tension regulator is operated upon by a vibrating diaphragm. Is that not true?—I do not understand it in that way.

You told my lord it compresses the tension regulator, and you said it increases the density. Do you mean to say you can have a coil of fibre and increase its density and not cause the fibres to approach more closely to one another?—No, I do not say that.

You mean to say if they approach more closely you have greater surface contact?—Yes, I should say so.

As a fact, you get a varying extent of surface contact?—In that sense we do.

What exception is there? In any one of Edison's tension regulators can you point out a case where you have not a variation of pressure?—In that remote manner it applies to all—amongst the particles of which the tension regulator is composed.

And does not that produce a variation in resistance and a variation in current?—Yes.

Is not that exactly what you said before was not the case? Is it not true that what you said with reference to microphones and the action upon the microphone—the sound waves being caused to operate upon it and to vary the action of the current in the circuit with which it is connected—is not the corresponding action exactly the same in the Edison?—No, it is not.

Why, you have just told me, step by step, that it is the same!—No; I do not see it in that light.

Is it not true that in both cases the sound waves are made to operate on a tension regulator in a closed circuit?—Yes.

Is not the action in each tension regulator to vary the extent of surface contact?—Yes, as I have qualified it.

Mr. JUSTICE NORTH: But I do not understand that you have qualified it?—It is only in the molecules of the structure—in the minute specks of carbon—that it takes place.

Mr. ASTON: And synchronously with that the electric current would vary in its action, and the result would be the reproduction of articulate speech at the receiver end in both cases?—Yes.

Are not the tension regulators used, as described by Edison, of various forms?—Yes.

And he tells you, does he not, that many useful and important modifications may be made?—I do not remember it, but I have no doubt it is there.

Look at page 4, line 36. Now you have pointed out what I will call a fibre tension regulator. Is that a delicate tension regulator?—I do not know; I have not seen it.

Exactly what I expected.

Mr. JUSTICE NORTH: Does the exhibit handed you look like a fibrous regulator?—It might be so.

Mr. ASTON: The trial before Lord McLaren took place in 1882?—I believe so.

When did you know you were going to give evidence here to-day?—I think it was in March last.

You were in Court during the action before Lord Justice Fry?—I went in one day to the public part of the Court.

Were you not consulted with reference to it?—Yes.

And then or now have you thought it worth while to try the very first tension regulator described by Edison?—I cannot say I have.

Mr. JUSTICE NORTH: On whose behalf were you consulted?—The defendants'.

Mr. ASTON: I believe you were ready to give evidence if called upon. Your proof had been taken?—No, not in that case.

You have been engaged in the many telephone cases?—I believe in all of them.

After a brief adjournment,

Mr. ASTON: On page 6, line 4, Edison describes, does he not, a tension regulator which consists of two surfaces in contact, each covered with a surface of plumbago—that would be a plumbago regulator?—Yes.

By a plumbago regulator I mean that the surface would consist of plumbago, and nothing but plumbago.—No, I do not understand that. I do not understand that clause at all.

You cannot understand two surfaces coated with plumbago being in contact?—Yes, I understand that.

That is what he describes.—No, I don't say that.

Is not one a disc? Can you not imagine a disc coated with plumbago by rubbing it? You know, I suppose, that if you rub plumbago on any hard surface more or less smooth, you coat it with plumbago. Cannot you imagine that back (?) brought into connection with a diaphragm covered with plumbago; and would not the contact be plumbago?—It would depend upon the thickness with which it is laid on.

Mr. JUSTICE NORTH: But it says "covered;" it cannot be covered if it is only partially covered, strictly speaking.—No, but you can put a very thin film.

Mr. ASTON: Assuming that all the parts are covered with plumbago, then you would have a pure plumbago tension regulator?—Yes.

Is it not true that Edison's telephone was called in the first instance by people who ought to know, the "carbon" telephone?—It was.

Being pre-eminently that in which a carbon tension regulator is used?—Yes, it was. You mean that he actually used?

I mean that he describes here.—Oh, no; I do not say that.

Had you seen any other in 1879 than this?—Yes; in 1878.

And was not that called the "new carbon telephone?"—I do not know that it was.

You are Mr. Conrad Cooke, are you not? You are the gentleman we heard with so much pleasure giving a lecture on telephones when Professor Tyndall was in the chair at the Society of Arts on May 21st, 1879?—I did give that lecture.

Were there not two Edison telephones you knew—two transmitters?—Yes; one a carbon telephone, another a chalk silicate (?)

And was not one called the "carbon telephone"?—I do not know that that was the name given to it. It was a new carbon transmitter at that time.

And you used it?—Very possibly I did; but I do not know that that was the specific name given to it.

Having so said, I will ask you to read at page 6, line 29: "In some cases I make use of the best quality of lamp black"—(That is carbon, is it not?—Yes, a form of carbon)—"to form the tension regulator." Would not that be a pure carbon tension regulator?—No, not pure carbon.

Nothing but carbon and the air?—No; I mean something more than that. That is a hydro-carbon of an oleaginous character.

Was not the form in which that carbon was prepared a convenient form to press it together?—No, I should say not.

Would it not be a convenient form to make a button of it?—No.

Do you know of its being used in the form of a button?—Yes.

Was not that a common form?—No, not a common form.

What carbon button was used, then?—It was compressed soot.

I thought lamp black was a kind of soot?—It is.

And compressed lamp black would be compressed soot, would it not?—Yes.

And compressed carbon, made of compressed lamp black, could be put in a case?—Yes, it could be put in a case, but it could not be easily made.

That was what was done with the Edison carbon telephone?—Yes, it was.

Now, in that case you had, had you not, a tension regulator formed of carbon?—Yes.

Now, at page 7, line 13, Edison says distinctly, "having points made of compressed plumbago."—Yes; mixed with gum rubber.

I know; mixed preferably. But suppose you do not prefer to mix; then you have plumbago points. That would be pure plumbago; pure carbon, and nothing but carbon?—Yes; plumbago is a form of carbon.

Mr. JUSTICE NORTH: But I do not understand that to mean pure plumbago.

Mr. ASTON: I was giving it the alternative reading, my lord. I do not care whether it is plumbago mixed with gum rubber, or pure, without gum rubber.

Mr. JUSTICE NORTH: It looks to me like plumbago mixed with something.

Mr. ASTON: If you remember, it was put both ways by the Attorney-General. But whatever you consider the right reading I will accept. The other will answer my purpose. (To Witness)—Mixing with gum rubber, being a substance not liable to rapid decomposition, is for the purpose of holding the plumbago together?—No, I don't think it is. I think it is to give it a semi-conductive and elastic form.

He does not say so?—No. As I have said before, in all these cases it requires a certain amount of elasticity.

Now, don't say in all these cases.—And he obtains a semi-conducting property, not only elasticity, by mixing plumbago with rubber, as I understand it.

In this particular form?—In this particular form I think it is necessary to have the rubber in order to get the semi-conductivity.

That is what you say. Now, might it not be simply for the purpose of making the particles of plumbago adhere?—I think not.

Why, then, must it be a substance not liable to rapid decomposition?—To prevent its being destroyed.

Would not any sticky substance, not liable to rapid decomposition, be capable of being used?—I think not.

Edison does not say it is not compressed plumbago, that it is to have semi-conductivity given to it by mixture.—I understand from the context of the whole patent that that is what he meant.

Very well. Then let us go down to page 7, line 27. Does not he there speak of a tension regulator of fibre or of plumbago in the alternative and in contradistinction one from the other?—Yes, certainly.

Then if you have a tension regulator of plumbago, why do you say it must be mixed?—In the one place he has referred to a previous fibre, in the second he is referring to the "above plumbago," or the plumbago mixed with gum rubber.

At page 7, line 37, he says, "r^2 is the plumbago contact point." He does not say about mixing it with anything there. There is no direction for mixing.—No, I don't see it.

That would be pure plumbago?—It might, or might not.

Mr. JUSTICE NORTH: He has taken that for what he has just mentioned.

Mr. ASTON: Very well, my lord. Speaking of Edison's carbon telephone as described in this specification, would it have been wrong to say, "The action of this beautiful instrument depends upon the varying resistance of a carbon disc due to variations of pressure exerted upon it by the movement of the diaphragm under the influence of sonorous vibrations impinging upon it?"—No, I hardly think it would. Not as he describes it.

You have told me, you know, that the best quality of lamp black or soot might be used in the form of a carbon button, and that it was so used?—Yes.

Then it would be true to say, "The action of this beautiful instrument depends upon the varying resistance of a carbon button," &c.?—That is perfectly true of the Edison transmitter which I was referring to, if you are quoting my lecture before the Society of Arts, and that is not the instrument described in his specification.

If you had a carbon button as described on page 6, line 30, it would act as a good tension regulator?—Yes, under very careful adjustment.

But it would act as a tension regulator?—Yes, under exceptionally careful adjustment.

I suppose that carbon button, if introduced into a closed circuit, would cause variations in the electric current corresponding to pressures produced upon it by a diaphragm vibrated by sound waves?—Yes. I don't remember ever seeing the first carbon telephone.

Assuming that this lamp black or soot is in the form of a carbon button, I ask you whether it would not vary any resistance offered to the electric current passing through the circuit if the carbons were acted upon by a diaphragm upon which sonorous sounds impinge?—It would vary its resistance.

And synchronously with the vibrations taken up by the diaphragm?—No, I cannot say that, for this reason, that it was with the greatest difficulty that that instrument could be made to work at all, because the adjustment required such intensely careful work.

But assuming you once get it to work?—Yes; but it will go wrong almost at once. I myself have adjusted those instruments when no one else could do so. The Edison Company presented me with a cup with an inscription engraved upon it, that it was given to me for the skill I had shown in making it work to show the Prince of Wales.

They have been ungrateful to you since?—I cannot say that they have.

You seem to speak as though you had some complaint.—I have no complaint at all.

You have not now. You have had in times past?—There was a matter, which was settled satisfactorily.

But unpleasant at the time?—It was unpleasant.

Now about the diaphragms. Did you hear Prof. Forbes say that as long as you had something which would take up the vibrations caused by sound waves it scarcely mattered in what form the device was?—For the purpose ——?

For the purpose of communicating the vibrations which it receives, say to a tension regulator?—I do not agree with that—not if you mean a tension regulator as described in the specification. I do not agree with him for the reason that he did not qualify the question of shape. He only took it in one dimension, not in two. He only took it in the plane—the outline of a plane surface.

Mr. MOULTON: Your lordship will remember that a picture of a curved shape was drawn by the Attorney-General and shown to the witness.

Mr. COOKE: I did not see that.

Mr. JUSTICE NORTH: It was drawn by the Attorney-General on a sheet of paper, and shown to the witness, and a person in the Court could not see it.

Mr. ASTON (to witness): Then you think the line that takes up the wave sound and so receives vibration makes a difference other than a difference of degree in result?—It makes a very great difference.

Other than degree?—That depends upon the way in which it is applied.

Did you not tell my lord that Theiler's instrument answered better when you simply spoke to the case?—I said I spoke inside the case.

Was it not the inside of the case that took up the sound-waves?—I think part may have, but the principal went direct to the microphone.

At all events the case with which the microphone was supported takes up some of the sounds?—In a less degree than if the door was shut.

Could the sound waves find their way to the microphone by sympathetic vibration?—Yes.

And if they were made in the vicinity of other portions of the instrument or case, would not every portion take up a portion of those sound waves?—I think it would.

And taking up a portion of the sound waves, would not the wood or cover produce an effect upon the microphone?—It would.

And would not that be exactly in proportion to the extent of the surface of the case upon which the sound waves impinged?—I think it would.

Would not that be entirely irrespective of shape and extent of surface?—Yes; in that way it would.

Perhaps you would like to qualify what you said before with respect to the shape?—I did not understand that question, because I did not see the drawing.

Mr. JUSTICE NORTH: Now do you agree with the answer given by Prof. Forbes?—I do agree with that.

Mr. ASTON: Do I understand you to say that in your opinion a slad of wood would not act as a diaphragm for Edison's purpose?—I did say so.

And that you repeat now?—Yes; I think so.

That is to say, if you take out the ferrotype plate ordinarily used and put in a thin disc of wood, that would not answer?—I mean that it would not answer as a good telephone.

That is not the question.—Do you mean that it would not speak? Yes.—No, no; I did not say that. It would speak nearly as well as the other. I have used wooden discs for various telephone experiments, but do not remember using one in connection with any of Edison's.

Have you ever tried the experiment of a mica diaphragm in connection with an Edison telephone?—I think not.

Nor a wooden one?—Nor a wooden one.

Mr. JUSTICE NORTH: You say: "I do not mean a wooden one would not speak; I think it would be nearly as good as the other." What do you mean by "would not answer"?—It would so very soon curl up under the influence of moisture.

Mr. ASTON: Does this objection apply to the slad of wood used in the Ader?—To a small degree only.

Why in a small degree? Because of the size of it?—No; because the question of curling up or altering its flatness is all-important, and is the vital question when you use the tension regulator of Edison.

How many months' experience do you speak of when you speak of this as a vital question? When did you try one of them?—I have not tried one at all. I know that it would be very bad to use a diaphragm that would curl up.

Does the Ader curl up?—Yes, I think it would.

Mr. JUSTICE NORTH: Did you ever know one curl up?—I have known it warp.

Mr. ASTON: And would it not work?—Yes, I think it would; simply because you do not require that adjustment of distance.

Where did you see an Ader that was warped?—I think that one (the exhibit) has been. Another reason of Edison's for excluding wood is that it is liable to injury from knocking about.

You say Edison excludes wood?—Yes, I think he does.

Is it not true that mica would be free from the difficulty you speak of arising from moisture?—I think so.

Is it not true, owing to its laminated character, that it could be used of any thickness?—Yes.

And is it not true that it would answer the purpose proposed by Edison in the way that he says?—Yes.

I am told that in the Gower-Bell transmitter the slads of wood are used in thousands, and that the complaint you make is not a complaint that is made with reference to those slads of wood. Do you know of many in which these complaints are made?—No; because I think it is perfectly unimportant.

Mr. JUSTICE NORTH: Have you any practical experience as to whether the Gower-Bell, or the other, curls up?—Certainly I have; I have one myself used for transmitting the notes of an organ to a distant station which is curled up. But it is perfectly immaterial for the Gower-Bell and the other.

Mr. ASTON: You cannot speak of personal experience in connection with the Edison?—Yes, I can. Not from personal experience from trying that particular experiment. From personal electrical experience, yes.

No, no, no! By personal practical experience?—If you ask me if I have made a special experiment in this case, I say I have not. From general electrical experiment I have.

You say that carbon is improperly described if described as a semi-conductor?—I think it is a very imperfect description.

Mr. JUSTICE NORTH: Suppose you took two thin pieces of wood and fastened one to the other, would you not get rid of warping?—No, not entirely.

Is it not practically got rid of? Two well seasoned pieces of wood, fastened together back to back?—That would diminish it very much, but not entirely.

Not practically?—I do not think so, my lord. If one piece were a little more soft—and if you cut them from the same piece it would be so—the hardest would curl least.

Mr. ASTON: With regard to conductivity; you say carbon ought not to be called a semi-conductor. Might it be called a partial conductor?—Yes; it is a pure question of comparison.

Now, comparing carbon with copper wire, would it be fair to call it a partial conductor, or semi-conductor—in comparison with a line wire of copper?—Yes; I would go even further than that and call it a bad conductor.

And therefore it would not be a great stretch to describe it is a semi-conductor?—As compared with copper certainly not.

And you know that Edison intends his carbon tension regulator to be enclosed in a closed circuit, which is often made with copper wire?—Yes.

You think, then, that the term semi-conductor as applied to carbon is not an unfair application?—As compared with the circuit in which it is placed, I think it is a fair expression.

Re-examined by Mr. PLUMPTRE: Is there anything in the specification which makes you think that Edison, when he spoke of semi-conductors, meant it in comparison with copper?—Oh, no, I think not. He was speaking of the various materials which there are in the world which you would choose to make a tension regulator of.

Mr. JUSTICE NORTH: I think he speaks of the line wire.—Of course, my lord; but he is speaking here of a material to make a tension regulator.

Yes; but it is a tension regulator to be used in connection with a line wire?—Yes.

Mr. PLUMPTRE: Then he often takes something which is a good conductor, and by mixing it with a bad conductor, produces a semi-conductor?—Yes.

Mr. JUSTICE NORTH: Where is it mixed with a bad conductor in the case of lamp-black?—In the powdered form it is a mixture of air and carbon. Taking silver, the very best known conductor, if powdered its conductivity is very much less than that of a mass of silver.

Mr. PLUMPTRE: You have been asked a great deal about a carbon button. Do you find in the specification of 1877 a single mention of the words "carbon button?"—No, I have not found them.

Is there any previous mention of the words?—I think not.

You have been asked to define the distinction between what is known as varying the line resistance by compressibility, and what is known as microphonic action. Take the case mentioned in Edison's specification, where the tension regulator is made of tufts of silk, and take the case where there is a heap of nails with the electric current running through them. Can you tell me whether you vary the current by speaking on that bundle of nails, and whether you get the same result when you speak on the fibre?—Speaking to the fibre and to the nails would not have the same effect. I should say speaking to a tension regulator of fibre would have no effect whatever; whereas the other is a very good transmitter.

Mr. ASTON: When that experiment was made with the tapes, were they nailed to the floor?—The floor was covered with kamptulicon.

But there was connection—the nails were driven into the floor?—Yes.

Mr. PLUMPTRE now suggested that the experiments arranged on behalf of the defendants should be made.

Mr. JUSTICE NORTH acquiesced, but remarked that he did not look upon experiments as supplying evidence, but as something to enable him to understand what he was not familiar with, and the better to understand the witnesses.

The experiments were then proceeded with, the mouth-piece consisting of putty, that of lead, and a wooden block used instead of a mouth-piece, being each tested, as well as several of the other transmitters put in. The transmitters were placed in the judge's room at the rear of the court, and several receivers in the Court were connected and listened to by the Judge and the learned counsel, and others. These concluded,

Mr. JAMES NELSON SHOOLBRED, consulting engineer, was called, and after the usual statement that he was acquainted with the matters before the Court, he said, in examination by Mr. PLUMPTRE, that he read the function of the diaphragm, as described in Edison's specification, to be to receive and transmit vibrations of sound. As to the meaning of diaphragm itself, he agreed with the general definition of its being a separator from side to side of the passage or chamber which the vibrations passed. He thought it must not be merely a projection, but something which passed right across—the word diaphragm, as he understood it, meant "right through." The diaphragm in the Edison specification was at the bottom of the mouth-piece—the brass plate. He did not find anything corresponding to or analogous with that diaphragm in the defendants' transmitter. In Edison's instrument, the pressure of a spring provided mechanical connection between the diaphragm and tension regulator, the vibrations received by the diaphragm from the voice being thus transmitted to the tension regulator. The microphonic pencil or tension regulator of the defendants' instrument received the vibrations from the human voice direct, and transmitted them to the blocks at the end, these being in electric connection with the line wire. The tension regulator used by Edison, and described in his specification, was of a different nature, and the action of the vibrations of the diaphragm in that specification upon the tension regulator was of a different character.

Mr. FREDERICK THOMAS HOLLINS, an electrician, and co-patentee with the defendants, was next called. He said he had been for sixteen years in the electric telegraph department of the Midland Railway Company, and had during that period made himself acquainted with telephony generally, as well as with the Edison transmitter, and that of the defendants' in particular. Replying to Mr. PLUMPTRE, he said he considered the diaphragm in Edison's transmitter to be the brass plate in the instrument and *b* in the specification. The instrument was made in three parts—mouth-piece, base, and back, with a tension regulator. He certainly did not consider that Edison meant either of these to be considered as a diaphragm, nor did anyone but the plaintiffs consider them so, that he ever heard of. There was certainly nothing in the defendants' transmitter in the nature of a diaphragm, as described by Edison, or as he understood the meaning and nature of a diaphragm. The black cone answered to Edison's mouth-piece, and the black-base corresponded, or nearly so, with the resonant case in the majority of figures in Edison's specification.

The Court here adjourned for the day.

THE PHONOPORE.

ONLY a few years ago, when the now obsolete watermen plied their avocation at almost every cab-stand in London, a gentleman asked a small boy the following question:—"Why are these men called watermen?" to which the boy lucidly replied, "Because they opens the doors of 'Ackney carriages." A Mr. Langdon-Davies, known, we believe, in connection with the Van Ryssel-berghe system of telegraphing and telephoning on the same wire, now comes forward with a new electrical instrument named the Phonopore, so called "because it affords a free passage to electrical effects associated with sound, such as telephonic messages and harmonic telegraphs, without permitting the passage of electric currents, such as ordinary telegraph currents. The instrument is not a conductor of electricity, and cannot therefore form part of a conducting circuit, as ordinarily understood."

The simple phonopore, we are informed, is neither a telephone nor a telegraph, but a means by which telegraphs and telephones can be worked together on the same wires, thereby utilising the telegraph wires already in position throughout the world, without the slightest interference with the work they are now doing.

The Phonopore, says Mr. Langdon-Davies, besides being a new instrument itself, comprises also a new system of construction, applicable to telephonic and telegraphic instruments, which permits the *addition* of the instruments so constructed to the ordinary telegraphs, so that the two kinds of communication can be carried on at the same time on the same wire, thereby enabling one wire to do the work of two. The following instruments have already been submitted to practical test:

1. The Simple Phonopore.

2. The Phonoporic Telephone Transmitter, which transmits the voice to long distances with great clearness and intensity. Telegraphic currents do not pass through it; it is only necessary to attach it to a telegraph wire and at once put it in action without interfering with the telegraphs.

3. The Phonoporic Telegraph Transmitter. This is a telegraph sounder, worked by an ordinary manipulator, such as a Morse key. It can be added to any ordinary telegraph wire and worked simultaneously with the ordinary telegraph, and it can be carried forward by means of simple phonopores, independently of the ordinary telegraphs, wherever there is phonoporic continuity.

4. The Phonoporic Transmitter. This combines in a single instrument both a telephone and a telegraph, and can be used to transmit either telegraphic signals by means of a key, or the sound of the human voice; it is neither affected by nor does it affect the ordinary telegraphs with which it is intended to be worked simultaneously on the same wire.

5. The Phonoporic Telephone Receiver. Intended to subdue the noises of telegraphs, and of electrical induction generally.

6. The Phonoporic Call. A loud sounding call for either telegraphs or telephones. Does not interfere with ordinary telegraphs.

7. The Phonoporic translator carries the telephonic voice from a double wire circuit forward on a single wire.

The instruments are not conductors of electrical currents as ordinarily understood. They are phonoporic conductors only.

Phonopores, goes on our informant, have been in action for more than a year on ordinary telegraph wires, upon which ordinary telegraphs are regularly at work. They have several times been struck by lightning without having been damaged. Although there are nearly 200 neighbouring wires, whose induction would seriously affect an ordinary telephone, conversation is not interfered with; the distance between the stations is nearly 100 miles, and has frequently been carried forward, as above described, to a much greater distance.

The above notes are offered by Mr. Langdon-Davies for the information of those interested in electrical progress. They relate only to the results produced, and do not pretend to describe the means. This latter information will be furnished shortly, and doubtless it will be eagerly scanned by those who have swallowed and thoroughly digested the appetising hash now set before them.

THE INVENTIONS EXHIBITION.

(1327) Messrs. Laing, Wharton and Down exhibit on their stall the various details of the Thomson-Houston system of electric lighting (fully described and illustrated in the REVIEW for Nov. 15th and 22nd, 1884), consisting of parts of the machines and lamps, focussing lamps, central station switchboard, lightning arresters, incandescent distributors, motors, current dividers to enable two arcs to be run in parallel and at the same time in series with others, ammeters, magnetos for testing insulation, and other accessories. They have also a good display of their own specialities in the way of glass shades and globes in a great variety of shapes and colours, switches, holders, cut-outs and similar appliances.

(1362) Messrs. Harrison, Cox-Walker & Co. have recently introduced a new surgical electro-magnet, for drawing small pieces of iron and steel out of the eyes, &c.; it will suit any battery, and can be made of almost any size and power to suit special cases or requirements. Their other exhibits comprise:—1. Electric tell-tale, for 30 stations, invented and designed by Mr. Cox-Walker, for recording the movements of watchmen, attendants, policemen, &c. These exceedingly useful appliances are now in daily use at several of the chief asylums, &c., in England, and have received great commendation. The record shows at what time any definite point was visited; how long the watchman or other person remained there; what station was next visited, and how long was occupied in going there. The whole apparatus is very simple; is easily attended to; cannot be tampered with; is not likely to get out of order, and is self-starting at any fixed time. 2. Electric

semaphore, for pit shafts, hoists, or other positions where it is important that an indisputable signal should be received from both the top and the bottom before the cage is started. The semaphore has two arms, one being thrown up by an electric current sent from the top by means of an ordinary push or tapper; and the other by a current from the bottom. The bell will only ring when both arms have been thrown up; and the arms are let down automatically as soon as the engine or cage is started. 3. Simple electric semaphore, for railways and mines. 4. Mining and railway signal bells and tappers. One, with a dome 12 inches in diameter, being furnished with a relay of special construction, in order that a strong blow may be struck from any distance by the action of a local battery. 5. Magneto-generator, with special driving arrangement for the armature; writing-desk, automatic switches, and simple electro-magnetic dome bell, for telephone lines. 6. Cox-Walker's new patent incandescent lampholders. These were described in the ELECTRICAL REVIEW for March 7th, 1885. 7. Fire alarm apparatus, for allowing any number of stations to be put on to one trunk line in connection with the central fire station. 8. Cox-Walker's new patent electric gong, for fire alarm, or with window or door contacts or other "burglar scare" arrangements. 9. Electric water level indicator and contact apparatus of simple construction. 10. Small electric motor, for light work, with new reversing arrangement. 11. Small incandescent lamp and lampholder, for surgeons and dentists, with new switch and flexible wire; very useful and convenient for the examination of the throat, teeth, and mouth. 12. New electro-magnetic tremolo bell, without contact breaker, for magneto currents. 13. New electric bell pushes, of Linthorpe pottery ware. 14. Sundry electric apparatus.

(1377) In the Stewart improved indicator discs are employed of a decorative character, and the indications they give are conspicuous and continue as long as is necessary.

(1395) Messrs. Faraday and Son's stall, though it belongs properly to Group XIII., for which the Eastern Arcade has been apportioned, is situate just outside it, that is to say, in the new Eastern Avenue, adjoining the Printing and Chinese Courts. Their exhibit comprises novelties in fittings, adapted for the service of incandescent lighting, more especially for domestic purposes. A switch in four sizes here shown has been patented by the firm under the name of the "Pointsman." Its chief features are extremely easy manipulation, immunity from imperfect contacts, and compactness, especially in the multiple form, for which arrangement it is peculiarly suited. This was fully described in the ELECTRICAL REVIEW for November 29th, 1884. Other switches are also shown, chiefly conspicuous for neatness and careful finish. There are also lamp holders (with varieties affording a ready means of detachment); couplings and connectors for flexible wires; swing brackets; portable fittings; electroliers, brackets, and standards of artistic design; pendants to rise and fall by means of spring rollers and counterpoises; shades and reflectors with spring supports. Loan exhibits of Messrs. Faraday and Son's design and manufacture are also to be found at the stalls of Mr. J. W. Swan and Messrs. Woodhouse and Rawson. They have also supplied the fittings for the Prince of Wales' Pavilion, the West Quadrant dining rooms, &c.

Bell's Asbestos.—Messrs. John Bell and Son's asbestos spinning and weaving machines are amongst the most interesting of those at work in the Western Gallery. Asbestos being a mineral fibre and having a perfectly smooth surface, requires to be spun by machinery quite distinct from that applicable to cotton, silk, wool and similar material. The art of spinning asbestos without the admixture of other fibres, dates from 1879, and from that time forward the use of cloth made purely of asbestos for protection against heat and in filtering operations has increased rapidly year by year. The great success of Maignen's "Filtre Rapide" is due to the use of asbestos cloth supplied by this firm. The process of spinning is a double one, the fibre having to be spun twice; in the rough spinning frame exhibited there are 50 spindles, and in the fine spinning frame 100 spindles, each spindle spinning about 2 lbs. a day.

Electric Lighting at Marlborough House.—On the 24th ult., the Electrical Power Storage Company temporarily installed 340 incandescent lamps in Marlborough House, of which 280 were of 20 candle-power, in frosted globes, and 60 were of 10 candle-power. In the ball rooms some of the lights were attached to the existing candelabra, and others were fixed round the cornice. In the Indian room 10 candle-power lamps, silvered on one side, were placed inside the cases to illuminate the Indian jewels. The saloon was mainly lit by lamps suspended from the existing fittings, but effect was obtained from a row of lamps placed out of sight at the foot of the pictures. The lamps in the conservatory, music rooms and passages were placed in tinted shades. The whole of the current for the lamps was supplied from accumulators placed in a tent in the garden. This is probably the largest temporary installation which has yet been worked in England from accumulators, the cells being brought, ready charged, from the works of the Electrical Power Storage Company at Millwall, a distance of about six miles

NOTES.

The Electric Light at Osborne.—A most noticeable feature of the illuminations with which the festivities at Osborne were terminated on the occasion of the marriage of the Princess Beatrice on the 23rd ult. was the electric installation on board Her Majesty's yacht *Victoria and Albert*. It consisted of a group of 100 incandescent lamps arranged in the form of the letter B, surmounted by a coronet, the whole being suspended between the main and fore mast of the yacht. The lamps used on this occasion were obtained specially for the illumination from Messrs. Woodhouse and Rawson at a very short notice, and consisted of 20 C.P. new filament 46 volt lamps. Electric current for the lamps was supplied by the Gramme dynamo worked in H.M. gunboat *Bloodhound*, which was moored off the stern of the royal yacht. In addition to the above effective device, a powerful naval search light of 25,000 C.P. was displayed at intervals, its pure beam of white light illuminating Osborne House, the grounds, and the various ships and yachts in the bay. The whole of the arrangements were carried out by the electric light staff of the naval torpedo school ship *Vernon*.

The Lighting of Offices by Electricity.—The Prudential Assurance Company has entrusted the lighting of its offices in Holborn Bars to the Electrical Power Storage Company. When completed, this installation will consist of 1,500 lights of 20 candle-power, and will be one of the most complete in existence, as, in addition to the storage batteries which will be capable of working the lights for 10 hours, the Marshall engines will be powerful enough to drive all the lamps direct. Three multitubular boilers, each of 45 horse-power, will be fixed, and two horizontal engines. We shall be pleased to hear of the successful completion of this important work, for electric lighting has previously been experimentally tried in a portion of the Prudential Assurance Company's building.

Electric Light Installation at Manchester.—We (*Mechanical World*) had recently the pleasure of an inspection of the electric light installation at the new offices of the Lancashire and Yorkshire Railway Company, Hunt's Bank, Manchester, which is being put in by Messrs. Woodhouse & Rawson. The offices are to be lit up by means of 500 glow lamps. The wires of the machine are all brought to two large switch-boards on the first floor, from whence they radiate to the different parts of the building; one switch-board commands the right side of each corridor and the other the left; so that the current can, by means of the keys at these switch-boards, be turned on to any part of the building that may be desired. The board room will be splendidly lit up by means of three 7-light chandeliers, and additional single lamps round the room, and for the private desks; this room, it may be mentioned, is about 90 feet long by 40 feet wide. The mains are carried along the corridors behind the skirting boards as far as possible, and in other places are encased in narrow boxes, which can be easily opened for purposes of inspection or repair when required. This firm supplied the installation for the old offices, in which there were 330 lights; this installation has been at work since April, and so far, we understand, has given every satisfaction.

Electric Lighting Patents in America.—The following announcement emanates from the American Brush Electric Company: "We commenced suit this week in Indianapolis against user of Jenney apparatus, sold by Fort Wayne Company, and other suits will follow. We now have more than a dozen suits in progress in various cities against infringers of Brush patents, and we propose to show no mercy. The Jenney apparatus is a clear infringement, and suits against them will be pushed vigorously."

Electric Lighting in Mines.—Mr. Sydney F. Walker, of Cardiff, has written to the *Times* upon this subject, strongly deprecating any suggestion of compulsory legislation, both as unjust to colliery proprietors, and unwise in the truest interests of the electric lighting industry.

Cheap Telephones.—The New Telephone Company has just brought out a cheap telephone invented by Professor Silvanus P. Thompson, and recently described by us. The company does not rent these instruments, but they become the entire property of the purchasers, thus avoiding all vexatious regulations and restrictions, annual royalties and rentals. An important point is that a substantial guarantee against any claim that may be made by trade rivals for alleged infringement is proposed to be furnished to each customer.

Bell again Triumphant.—The case of the American Bell Telephone Company against the Western Pennsylvania Telephone Company, which was on trial in the United States Circuit Court, Pittsburgh, ended in the Court granting a preliminary injunction against the defendants. The latter have 600 telephones in use in Pittsburgh, which they will now be compelled to take out. An appeal to the United States Supreme Court is considered out of the question, as two or three years would elapse before the case could be reached. The Western Pennsylvania people, it is stated, consider further litigation useless, and will retire from business permanently.

Telephonic Progress.—The new issue of the National Telephone Company's list of subscribers for the Scottish North-Eastern District (including the counties of Aberdeen, Banff, and Kincardine) shows an increase of sixteen since the month of April. There are now nearly 500 instruments in operation in the district. The latest list from the Edinburgh district also shows satisfactory progress.

The Telegraph Congress.—One of the most important questions before the forthcoming International Telegraph Congress at Berlin, we learn, will be Germany's proposal to introduce a uniform and moderate tariff for telegrams between European States. Under the present system many glaring inconsistencies and inequalities are stated to exist. For instance, a telegram from Rome to the French frontier costs 5c. per word, and from the frontier to Paris 5c. more; but a telegram from Rome to Paris costs 18c. or 20c., instead of 10c. As a result of this, the principal Italian newspapers have agents in Modane, a French town near the frontier, who receive despatches from Paris, then cross the adjacent frontier and telegraph them to Rome.

Mr. Floyer left Cairo on Monday last for Berlin, to represent Egypt at the International Telegraph Conference.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to July 25th, 1885, amounted to £525,000, against £520,000 received from April 1st to July 26th, 1884.

The Status of Telegraph Clerks.—"Uriah Heep" makes a stirring appeal to the new Postmaster-General in the current number of *The Telegraphist*, pressing for the inclusion of telegraph clerks in the lower division of the Civil Service, in accordance with the recommendation of the Playfair Commission, and for the payment for Sunday duty in the provinces as in London. He concludes his address with the following forcible words:—"You have it within your reach to make yourself extremely popular, and your name deservedly revered with a large and important body of men and women, as well as with the public at large; and you have it within your grasp to do yeoman's service to your country by retaining for it the labour of those whose training has cost the public both time and money."

The Persian Gulf Cable.—The Indian Government has decided to spend eight lakhs in renewing the Persian Gulf cable, which is in a state of decay, as manifested by the incessant breaks and stoppages.

The First Atlantic Cable.—We understand that Mr. Cyrus W. Field will give a dinner on August 5th, at which the American Minister and many representatives of the telegraphic world will be present, to celebrate the twenty-seventh anniversary of the completion of the first Atlantic cable.

Too Difficult.—Philadelphia, a city that owns its gas-works, is now ready to sell them, having come to the conclusion that it is too difficult for a city to carry on a manufacturing business economically.

The Distribution of Electricity.—A few weeks ago Messrs. Ganz & Co., of Buda Pest, forwarded to us a description of the Zipernowski-Déri system of distributing electrical energy. For reasons connected with patent matters we withheld the publication, but we are now enabled to present to our readers the particulars of this rival scheme to the Gaulard-Gibbs method.

Serious Accident to an Engineer.—James Watt, an engineer in charge of the electric light apparatus at the Forth Bridge, met with a serious accident on Tuesday. He was descending a ladder at No. 5 caisson, at Inchgarvie Island, when he missed his footing and fell a depth of 40 feet. His head was seriously cut, while most of his ribs were fractured, in addition to other injuries.

Is the Current Dangerous?—We read that while a trial was being made on the new electric tramway at Bessbrook on Saturday, a horse stumbled, fell on the wires, and was instantaneously killed by the electric current. The driver was slightly injured. Is not this the second horse which has been killed by the exposed conductor system? Had the cars carried their own motive power in the shape of secondary batteries this could not have happened.

Overhead Wires Retarding Firemen.—The chief engineer of the Philadelphia board of fire commissioners, referring to a recent destructive fire in the city, stated that the greatest drawback experienced by the firemen in fighting the flames was the net work of telegraph wires on both sides of the building. These prevented the use of the ladders in the early stage of the fire.

Underground Wires in Brooklyn.—The three commissioners who have charge of getting the telegraph wires and similar electrical conductors in Brooklyn underground within the time specified by law—George W. Plympton, Prof. Rossiter W. Raymond and John Reynolds—have met, and Mr. Plympton has been elected president and Mr. Reynolds secretary. They have passed a resolution that each company shall furnish to the commissioners before August 12th, a description of the plan (if any) by which it proposes to place its electrical conductors underground, and a full statement of the nature, location, and the extent of its conductors. If any company fails to furnish the desired information by that time, it must file a written statement of its reasons for so doing with the board. The same resolution provides that no new wires or poles can hereafter be erected in Brooklyn without the permission of the board, acting jointly with the Department of City Works. A resolution has also been adopted inviting all persons or corporations interested in a general underground electrical system to present their views in writing, or otherwise, as speedily as possible.

Influence Electric Machines.—The article in our current columns by Herr W. Hempel, will be found of considerable interest to those who make a study of influence machines.

Sawdust Fuel for Electric Lighting Engines.—The Lewiston (Maine) Electric Light Company, according to the New York *Electrician and Electrical Engineer*, now uses sawdust for fuel, costing only 75 cents per cord delivered. It finds this fuel more economical than screenings for making steam. Its boilers are set with the Jarvis patent setting, and use Sheffield grate bars. It uses the Armington and Sims engines belted direct to the dynamos.

The Underground Wire Commission in New York.—Our contemporaries state that the prevalent feeling in New York with regard to the question of underground wires is, that the wires will stay where they are—on the poles. The comic paper *Puck* had a cartoon a week or so ago in which a citizen of New York was represented as putting a century plant on top of a pole. Asked why he did this, he replied: "Well, I want my grandchildren to see it bloom, and this is sure, now, to be a permanency." This is hardly a compliment to the new Commission. The *Electrical World* says it is likely that those who have expected to see a wholesale burial of the wires will be disappointed.

Woodhouse and Rawson's Lamps.—The following letters have appeared in *Invention* in reply to that of "An American Engineer," which we reproduced in our last week's columns:—"I notice in your issue of this week a letter from "An American Engineer," animadverting on the Woodhouse and Rawson lamp, and stating very unfavourable results of a test made at Philadelphia. The Woodhouse and Rawson lamps are neither the best nor the worst English incandescent lamps; but it would be fallacious to judge all English lamps from this trial. I do not think that there is any incandescent lamp to beat the Swan lamp, and "American Engineer" had better keep back his judgment until some of the best forms of English lamps have competed in America. FAIR PLAY.

"London, July 18th, 1885."

"Your issue of 18th inst. contains an unwarrantable attack on the Woodhouse and Rawson lamp. I am not aware of the circumstances under which the experiments were carried on in the States, but I feel convinced, from the excellent work done by the firm, and the experience which I have had with their lamp, that the test in point was very unfair to them. I shall look forward with considerable interest to the explanation which the firm will, doubtless think proper to give of the occurrence. ENGLISH ENGINEER.

"London, 20th July, 1885."

She Drank the Battery.—In Philadelphia, last month, Jane Beatty, 57 years old, drank a wineglass of battery fluid composed of sulphuric acid, sulphate of copper and bichromate of potassium in mistake for a dose of tonic bitters. The internal resistance was not equal to the E.M.F. of the battery, and so Jane died the next day.—*Electrical World.*

Official Changes.—Mr. J. E. Hudson, attorney of the American Bell Telephone Company, has succeeded Mr. Theodore N. Vail as general manager.

Wires in Detroit.—The Committee on Judiciary of the Lower House has decided that the telegraph and telephone wires in the City of Detroit must go under ground. Our New York namesake suggests that if the Committee will also decide to make the wires work satisfactorily underground, the telephone companies will appreciate the kindness.

The Assault at the Inventions Exhibition.—Few will regret the severity of the fine inflicted on the "electrical engineer" who, when remonstrated with for lighting matches and smoking at the Inventions Exhibition, contrary to the regulations, turned on the exhibitor who pointed out to him the dangerous character of his act, and savagely assaulted him. The enforced payment of £5 was rather too small than too great a punishment for such insane and brutal conduct.

A Meteorological Station for Queensland.—We learn that Mr. Clement L. Wragge, F.R.G.S., late of Ben Nevis Observatory, intends to visit Brisbane shortly, calling at Melbourne and Sydney, on matters relating to meteorological work in Northern Queensland and New Guinea.

Storage Batteries.—We hear that an important action will shortly—probably in the course of a few days—engage the attention of the courts in which the question at issue will be an alleged infringement of storage battery patents. The Electrical Power Storage Company will apply for an injunction against Elwell-Parker, Limited, whose storage batteries, together with those of the suing company, have recently been the subject of considerable correspondence in our columns.

Incandescent Lamp Patents.—Another *cause célèbre* in electrical circles will be the action brought by the Edison and Swan Company against Messrs. Woodhouse and Rawson for infringement of the Edison incandescent lamp patents. This case, it is stated, will probably come on for hearing in November.

United Telephone Company v. Bassano and Slater.—Up to the time of our going to press the judgment in this case was yet to be given by Mr. Justice North. The evidence on both sides was completed on Saturday, July 18th, and on the following Monday the opposing counsel addressed the Court on behalf of their respective clients.

The Blackpool Electrical Tramway.—This tramway, which has been laid along the promenade at Blackpool, was inspected on Wednesday by Major General Hutchinson. He was met at the station by a deputation of cabmen, who laid before him their grievances with respect to the manner in which the line has been made. He afterwards went over the entire length of the line, a distance of two miles.

The Phonopore.—We would like to ask Mr. Langdon-Davies what results have been achieved in this country by the use of the instruments described in our other columns?

Hedge's Speed Gauge.—Captain J. Shiffner, writing to the *Engineer* respecting the engraving of this gauge which has appeared in that journal, and our own, says:—"The dotted lines showing the different parabolas, formed by the section through the axis of the paraboloids due to the different rates of velocity, are all drawn to meet at the top edge of the tube. This could only be the case if the tube were open at the top, so that the water could run over as the speed increased. In this case, the equation to the parabolas being

$$y^2 = \frac{2g}{w^2} x$$

—where y is constant, being the radius of the tube—x, the depression of the water, would vary as the square of the angular velocity, not directly with it. It is not till the water reaches the closed top of the tube, and the diameter of the paraboloid at the top begins to decrease with any further increase of speed, that the depression of the water begins to vary directly as the angular velocity, this being due to the volume of the air, which is

$$\tfrac{1}{2}\pi y^2 x$$

—where y is the radius of the paraboloid at the top of the tube—*i.e.*—

$$\pi \frac{g}{w^2} x^2$$

being constant; so that x varies directly as w."

Fatal Thunderstorm in Italy.—During a violent thunderstorm last week at Torre Cajetani, a small market town in the neighbourhood of Anagni, Italy, 13 persons were killed and 22 severely injured by the lightning.

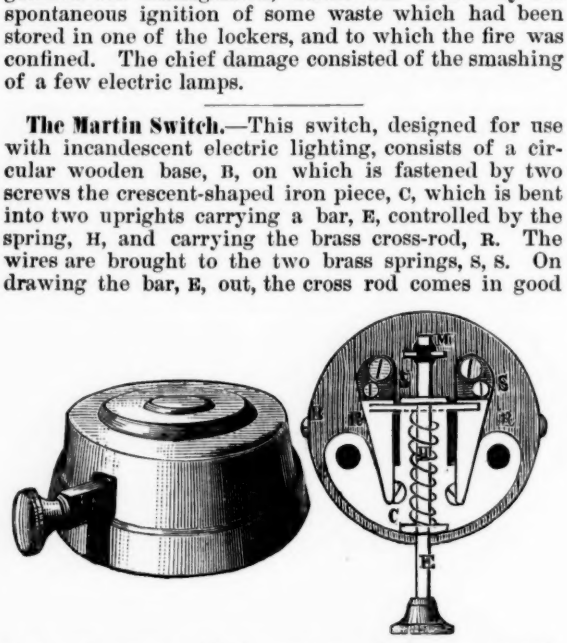
Electric Motor Tests.—A third trial of the Daft electric motor was made on the Union Passenger Railway on the 8th ult. The trip was satisfactory, and it was said that this test was probably the final one, it being intended to commence the permanent service a few days afterwards.

Cutting Wires in Washington.—The telegraph and telephone wires on the roof of the Treasury Department at Washington were removed by a force of treasury labourers on July 8th. All those not for the use of the Government were cut down and bundled up in huge piles at the foot of the nearest telegraph pole to which they were attached. The linemen of the companies went around afterwards and gathered up their tangled property.

Professor Tyndall.—Lord C. Hamilton asked the Vice-President of the Board of Trade on Thursday, the 23rd ult., whether Her Majesty's Government had had under their consideration in the interests of science and of the maritime welfare of the country, the advisability of requesting Prof. Tyndall to resume the position he recently occupied in connection with the Lighthouse Commission. Baron H. de Worms replied that in March, 1883, Prof. Tyndall resigned the office of scientific adviser to the Trinity House, the Commissioners of Irish Lights, and the Board of Trade. He had made no application to the President to be reinstated in that position.

Fire in Portsmouth Dockyard.—On Wednesday last week a fire, which fortunately resulted in comparatively trifling consequences, broke out in the electric shop in Portsmouth Dockyard. The flames were discovered at about a quarter to 1 a.m., and information was at once given to the Metropolitan police, who, taking their hose and reel to the spot, speedily extinguished the conflagration, which was caused by the spontaneous ignition of some waste which had been stored in one of the lockers, and to which the fire was confined. The chief damage consisted of the smashing of a few electric lamps.

The Martin Switch.—This switch, designed for use with incandescent electric lighting, consists of a circular wooden base, B, on which is fastened by two screws the crescent-shaped iron piece, C, which is bent into two uprights carrying a bar, E, controlled by the spring, H, and carrying the brass cross-rod, R. The wires are brought to the two brass springs, S, S. On drawing the bar, E, out, the cross rod comes in good



frictional contact with the springs, which force a notch on the bar, E, into the piece, M, holding the contact firm. When the contact is desired to be broken, lifting the bar, E, releases it at the notch, and the spring, H, causes the contact to be broken at two points with great rapidity. The switch is only supplied in Great Britain by Mr. C. R. Heap, but, with the exception of the notch in the bar, E, we may remark that a precisely similar apparatus has been for some time in use as an electric bell pull.

The Bernstein Lamp.—It will be seen that a company has been registered with the object of working this lamp in England.

The Royal Wedding.—In honour of the above event there were some grand displays of fireworks and illuminations in the neighbourhood of Osborne, and their effect was rendered weird and fantastic by the ships lying at Spithead exhibiting their electric search lights.

Registration of Electrical Measurements by Photography.—As bearing upon the article published in our issue of the 18th ult., it may not be generally known that the recording of electrical currents by photographic means was provisionally protected so long since as 1877 by Sir James Anderson, Henry N. Blackwood-Price and Henry G. Cheesman. The specification is dated 10th January, and the arrangement described therein, which scarcely differs from, and forestalls that of Messrs. Trowbridge and H. V. Hayes by eight years, is, in the words of the inventors, intended for registering the value and strength of earth currents, magnetic and electrical disturbances, and such like. We believe that this is the first instance of employing photography for such purposes, but Messrs. Trowbridge and Hayes are not the only scientists who have brought forward the same idea since the year 1877.

NEW COMPANIES REGISTERED.

Bernstein Electric Lamp Company, Limited.—Capital: £100,000 in £10 shares. Objects: To acquire and work the letters patent, Nos. 2604 and 6075, of the year 1882, and No. 3915 of 1883, relating to improvements in incandescent lamps, invented by Mr. Alexander Bernstein. The purchase consideration is £11,000 in fully paid shares, and a royalty of 2½d. for every lamp, constructed in accordance with such patents. Signatories (with one share each): *Alexander Bernstein, 9A, Commercial Road, Pimlico; Julius Maier, Ph.D., 23, Melrose Gardens, West Kensington; *Ludwig J. Mond, 20, Avenue Road, N.W.; *J. T. Brunner, Northwick; Walter E. Wynne, W. W. Wynne, and J. A. Holmes, 40, Chancery Lane. Directing qualification: 20 shares. Registered 29th July by Messrs. Wynne, Holmes and Wynne, 40, Chancery Lane.

Sharp and Company, Limited.—Capital £50,000 in £5 shares. Objects: To purchase the business of Mr. Sampson Low, jun., trading as "Sharp and Co.," and to trade as sanitary, ventilating, gas, water and electrical engineers. Signatories (with one share each): A. R. Vibert, 33, Frederick Street, W.C.; Sampson Low, jun., 11, Holborn Circus; E. Hughes, 7, Westminster Chambers; C. M. H. Craushay, 35, Azenby Square, Peckham; E. Maston, 188, Fleet Street; W. Clement Wells, 6, Billiter Street; J. Excell, 70, Winston Road, N. The signatories are to appoint the first directors, qualification 50 shares. Registered 29th July by Mr. Hugh C. Godfray, 101, Finsbury Pavement, E.C.

CITY NOTES, REPORTS, MEETINGS, &c.

Submarine Telegraph Company, Limited.

THE report of the directors states that the accounts for the six months ending 30th June, 1885, show the gross receipts to have amounted to £66,795 16s. 11½d., and a nett result which enables the directors to add £8,334 6s. 5d. to the reserve fund, and to recommend a dividend at the rate of 15 per cent. per annum, leaving a balance of £889 4s. 2d. to be carried to the next account.

The receipts for the six months exceed those for the corresponding months of the year 1884 by £4,038 5s. 0½d.

This increase arises principally from the general traffic, although there has also been an increase in the receipts from the special

* Signatories whose names are preceded by an asterisk are also directors.

traffic transmitted by the Indo-European Company over the wire in the Norderney cable, which they lease from the Post Office. The average length of the messages, however, in the six months has been shorter, being 11·72 words against 12·04 words in 1884. On the other hand the number of messages transmitted has been 85,011 more than in 1884.

Besides the increase in the receipts, there has been a decrease of £1,229 5s. 1½d. in the total expenses. The cost of repairs to cables has been £1,858 8s. 4d. less than in 1884, but the other items of expenditure show together an increase of £629 3s. 2½d., which sum includes £139 9s. 10d., a part of the extraordinary expenses referred to in the last report as having been incurred in overhauling and repairing the steamer in the half-year ending December, 1884.

The decreased cost of repairs to cables is due chiefly to the two Government cables to Holland having been—the one completely, the other partially—renewed by the Post Office, and consequently, being better able to bear the strain of fishing gear and anchors coming in contact with them.

In 1884 these cables were interrupted for 252 days, and in 1885 one of them was not interrupted at all, while the other was interrupted only for a period of 81 days, in the course of which a new length of about 32 miles was inserted in it.

The Company's cables in the Channel have also been remarkably free from interruptions, and at the present time all the cables worked by the company are in good working order.

The term of the agreement under which the Indo-European company worked a wire in the Government cable to Norderney, expired on the 24th December, 1884, and fresh arrangements have been made with that company for continuing the working of the Norderney wire, and also for a wire in the cable of the German Union Telegraph Company, under which the company will receive a small increase of income.

Cuba Submarine Telegraph Company, Limited.

THE twenty-eighth ordinary general meeting of this company was held at the offices, 61, Old Broad Street, on Wednesday, under the presidency of Mr. Joaquin de Mancha.

Mr. James Scott, secretary, having read the notice convening the meeting,

The Chairman said it was always very pleasing to the directors to meet their fellow shareholders, and more particularly so when they had a very good account to render, and even the most fastidious, he thought, could not but consider the one they now presented as being of that nature. They were at peace with all their neighbours, even with the Spanish Government, which had paid the money it acknowledged owing for a long time, amounting to £1,137. With that, and the earnings of the half-year, they proposed to recommend that a dividend be paid on the ordinary shares of 10 per cent. Last time he addressed them he predicted that that would be the case some day, but it had come rather more quickly than he had anticipated. He thought the accounts were very favourable. They had transmitted 2,000 more messages during the past half-year than during the previous one; their income had not increased in proportion, but still it was nearly £900 more than in June, 1884. All the other expenses were much about the same; there was a slight increase in the ordinary expenses of £160. They had been able not only to meet all expenses, but to pay £2,000 towards the cable which they had purchased, and which they paid for gradually, £2,000 every six months. The cables were working fairly. Of course, they were getting a little antiquated, but they were working as well as they could expect them to do. This half-year they had been particularly fortunate, for they had had nothing to pay for repairs, whereas in the June of last year they had £2,000 to pay for the repairs that were then completed. He moved the adoption of the report and accounts.

Mr. Alexander F. Low seconded.

A Shareholder enquired whether the directors expected much advantage from the opening of the Panama Canal, when that took place.

Mr. Greenwood congratulated the board on the satisfactory state of things they had been able to show, and afterwards suggested the advisability of endeavouring to bring the whole of the shares of the company into one class, instead of preferred and ordinary, so that there should be no division of interests.

Mr. Griffith concurred in the advisability, but pointed out that there were legal difficulties, and that the only way to effect the change would be by individual treaty, offering a premium to preferred holders to exchange their shares for ordinary shares. He further said he could not understand how it was that, notwithstanding the fact that the trade with the West Indies was falling off, this company continued to prosper.

The Chairman said that probably the reason their business did not decrease on account of the bad trade, was that their cable was rather a peculiar one, and did not so much depend upon the course of trade as others. There was a great deal of communication between the island of Cuba and Spain, and to this he greatly attributed the continued progress of the work. As to the Panama Canal, he thought there was no doubt if any fresh communication were opened up, or whatever business went on, they were sure to derive some advantage, but whether that would be large or small it was impossible to predict. At the last meeting they were rather found fault with for having too much money in some banks; they had tried to meet that, and had decreased the amounts in several instances, the largest now being £10,000 in the Bank of India, than which he did not think there was a better bank in the City of London. With regard to the preference shares, they were willing to take any initiative the shareholders might propose to them, but it was a matter of some difficulty. If they were able to continue paying 10 per cent on the ordinary shares, the preferred holders might be induced to take ordinary shares instead of their preferred, if some premium were allowed them.

The resolution was then put, and carried unanimously.

The Chairman moved, "That the following dividends for the half-year be now declared upon the shares of the company, namely, at the rate of 10 per cent., subject to income-tax, on the preference shares, and 10 per cent., free of income-tax, on the ordinary shares, payable on and after July 30th."

Mr. Low seconded, and the resolution was carried.

Mr. Neil Bannatyne and Mr. Thomas Greenwood were re-elected director and auditor respectively, and votes of thanks having been passed to the chairman and directors, and to the employés of the company at home and abroad, the meeting terminated.

Railway Electric Appliances Company, Limited.

THE second ordinary general meeting of this company was held at the Cannon Street Hotel, on Tuesday, under the presidency of Colonel R. Raynsford Jackson.

Mr. William Shepherd, the secretary, having read the notice convening the meeting,

The Chairman, in moving the adoption of the report and accounts, said the circular which he had sent to the shareholders, and the report which they had in their hands would place them in full possession of all the facts relating to the present position of the company. There was a great contrast between the present position and that of two years ago. Then they were entangled in a series of law suits, which in all probability would have exhausted, not only the capital then called up, but all the uncalled capital. He did not know that he could give them a better idea of what those legal charges might have been, than to state that there had already been expended in legal proceeding nearly £4,500. From this they might imagine what would have been the result to the company if the various actions had been pressed to the utmost extremity in the courts, and if the losing parties, as would undoubtedly have been the case, had appealed to the higher courts. He was happy to be able to record that they had succeeded, by compromises which he considered advantageous to the company, and with the circumstances of which they were already informed, in getting rid of the risk of frightful legal expenses to which he had referred. He would briefly point out what the effect of those compromises had been. In the first instance the capital of the company was 91,732 shares, upon which cash was paid of 12s. 6d. per share, and 78,500 that were issued fully paid up, making a total of £170,232. Under the arrangements with the litigants 41,031 of the 12s. 6d. shares were surrendered, under the arrangement sanctioned by the shareholders in April, 1884, and 50,350 fully paid shares were surrendered, making together 91,381 shares, and leaving the capital of the company £78,851. Upon the 50,701 ordinary shares remaining £31,869 had been paid up, which, with the 28,150 fully paid up shares, left the capital of the company entitled to a dividend, if they could pay a dividend, at £60,019. The most important compromise which had been made was this. The fully paid up shares held a preferential position, and supposing they had liquidated the company when 78,500 of them existed, their preferential position of 7s. 6d. per share would have amounted to £29,437 10s. The 50,350 shares that had been cancelled accounted for £18,881, and the preferential position occupied by the fully paid up shares at present was only £10,556. It must be a great relief to them to feel that they had got rid of that grave and overwhelming incubus. During the current half-year the result of the Rosehill works had been much more satisfactory than hitherto. There was a loss, but it was a very small one. All the small patents held by the company gave very satisfactory results. Relatively very large returns had been derived from the wagon-fastener, and there was still a prospect of their receiving a considerable revenue from that small patent. The compensator invented by Mr. Henry Williams was likely to be of great importance to the company hereafter. It had been tried by most of the principal railways, and several of them had given a second and one or two third orders. Major Marindin, of the Board of Trade, had expressed his great approval of the invention, and had given Mr. Williams permission to state that he thought so well of it, so that they would probaby get something towards a dividend out of the compensator. The directors hoped the long-continued bad trade would come to an end soon, when there would be a greater prospect before them of placing the company in a more satisfactory position. £2,000 had been put down in the accounts for directors' remuneration. The directors had had no intention of receiving the full amount due to them, but it turned out, in order to get through the compromises to which he had referred, it was necessary to come to an arrangement with the party who was blocking their action, and his arrangement was that certain expenses should be paid by the directors instead of being paid, as authorised, by the company. The directors had therefore paid £1,151, which the company would have paid. He concluded by moving the adoption of the report and accounts to 31st December, 1884.

Sir George R. Prescott seconded the motion, which was carried unanimously.

Lieut.-Col. Elliott was re-elected to his seat on the board; and the auditors were also re-elected.

The Chairman intimated that Mr. Arrol, one of the retiring directors, would not seek re-election, as he was residing in Glasgow, and it was impossible for him to attend the meetings of the board.

A vote of thanks to the Chairman having been passed, the proceedings terminated.

Globe Telegraph and Trust Company, Limited.

THE twelfth ordinary general meeting of this company was held at the Cannon Street Hotel on Tuesday, Mr. John Pender, M.P., presiding.

Mr. Payton, the secretary, having read the notice convening the meeting, and the minutes of the previous meeting having been read and confirmed,

The Chairman said: Before moving the first resolution asking you to approve of the accounts, I shall as usual make a few remarks upon what has occurred during the last year. The important point to-day is, that the dividend this year on our ordinary shares is less than last by ¼ per cent. or 6d. per share. The cause of this is not very far to seek; it arises from the falling off in the amount that we have generally received from the Anglo-American Company. In our financial year 1883, the Anglo-American and Direct Companies paid us £46,356; in 1884 they paid us £44,795; in 1885 (the present year) they paid us £38,467, or £6,218 less than in 1884, which is sufficient to account for the 6d. reduction in our present dividend on the ordinary shares. Now, you will no doubt ask me what are our prospects in regard to the Anglo-American Company. In regard to the other companies, I may say, from the Eastern Company and the Eastern Extension Company there has been a steady increase of income, and I see no reason to doubt that that income will be a permanent one. Therefore, so far as the Globe is concerned, those who are holders in the Anglo-American Company are materially benefitted, and those who are holders in the Eastern Company have no reason to regret investing in the Globe. It has given them additional security, and, I may say at the same time the Eastern and Eastern Extension Companies have materially assisted in maintaining the dividends. I may also add that the Brazilian Company has equally been a good source of income, and I see no reason to doubt that that income may be retained. As to Atlantic companies we are passing through a crisis. We have more cables in the Atlantic than the traffic and public requirements demand. Some of these cables have been laid, in my opinion, without reference to return. It may have been in a spirit of ardent enterprise or from personal considerations. At any rate the cables are there, and we have to contend with them. I cannot believe that those who have placed their money in the Atlantic will allow it to remain there without some return, and it will become a question with these companies to consider the best course to pursue to bring about such a return as I believe we are fully entitled to. I am speaking now as one of the largest shareholders in the Anglo-American Company—because the percentage that we hold of the Anglo-American is something like one-third of our capital. Therefore upon the success or non-success of that company very much depends a good or an indifferent dividend for the Globe. We shall endeavour to use what influence we possess in the Globe to bring about such an arrangement as will secure a better dividend than we are receiving from them to-day. It is not for me to use threats of any kind, because that is not business; but we shall endeavour in such, which I hope will be so successful as to secure the real object we have in view, and it may be that we may pass probably six months—we may have twelve months—of a very anxious time, and I do not say that during that time we may not have even a lower dividend than we have to-day; but the result will be that the question will be settled in such a way as to give a fair and reasonable dividend, and when we get into that state the Globe will then be in a position to pay the dividends—fair dividends, but not large dividends—which we have paid during the last few years. I must mention just in alluding to this, that though we have only received during the past five years 3 per cent. from the Anglo-American Company, we have paid 6 per cent. upon our preference shares, and we have paid at the rate of 4½ per cent. upon our ordinary shares, and taking the two together this gives an average of about 5¼ per cent. That is what we aim at. The object of the Globe was greater security for the shareholders, and greater security never means very large dividends. However, I may simply state that I believe that the shareholders of the other submarine companies are watching very closely the different interests which they represent, and I think that the day is not very far off when we shall be able at all events to open up negotiations or decide upon such a rate as will make it a very unsatisfactory business for those who have what we call entered upon our ground without any sound reason whatever. The new cables that have been put in the Atlantic have been simply put there, as I have said before, without any reason that I can see with the view of a profit. They are not required; and consequently, instead of creating or contributing in any way to develop the traffic, they have simply taken away a portion of the existing traffic. They have done worse than that: they have reduced the rates, and consequently they have thrown into the sea something like £150,000 upon the reduced from which they have derived no benefit whatever. With these remarks I beg to move that the report and accounts of the directors for the year ending July 30th, 1885, submitted to this meeting be, and the same are, hereby received and adopted, and that a dividend be now declared of 3s. per share on the preference shares, making with previous quarterly payments a total dividend for the year of 6 per cent. on the preference shares, and 3s. per share on the ordinary shares, making with previous distributions a total payment for the period of 4½ per cent.

Sir Daniel Gooch seconded.

Mr. Weatherly claimed the indulgence of the board, because he found that when matters proceeded from his side of the table it was often interpreted as a kind of antagonism to the gentlemen sitting on the other side. He had received a report of the proceedings at the meeting of the Atlantic cable proprietors last week, and he observed that there was a remark made *apropos* to the remark he was about to make on the statement put before them, and that remark was deemed by the chairman (Mr. Pender) to be a puerile remark, or a paltry one. Few of the shareholders, he believed, ever took the trouble to closely examine the accounts presented to them; they attended the meeting for a quarter of an hour, received the chairman's statement and the accounts, and never compared these with former accounts. Gentlemen would be very much surprised if they compared the accounts of 1874 with those of 1885. The question was one for the ordinary shareholders; the preference holders got their 6 per cent. whatever the charges were, but the ordinary holders had to pay the whole amount. Therefore when the ordinary shareholders found their dividends reduced by 1 per cent. it naturally made them look into the accounts to see how that reduction had taken place; and he contended they had no right to sit there that afternooon, passing the accounts, and saying, "We will be content with 4½ per cent.," when they ought to have, according to the prospectus which the directors issued when the company was formed, a dividend of 8 per cent. In 1874 there were ten directors on this board, their remuneration being £1,000, a very fair remuneration, he considered, when it was remembered that all those gentlemen were directors of other two, three, or four cable companies, in which this company held shares. Now there were only six directors, and the remuneration was £1,500. The salaries paid in 1874 amounted to £787; in 1885 they were £1,425. What could be the work in a company of this kind, where the dividends were received from other companies and paid over to the shareholders, to necessitate such an increase. He had made enquiries at the offices and learnt that there were six clerks employed, whilst at dividend time several other clerks were employed. They could easily imagine that at such times additional help was necessary, but surely a few £5 notes would cover it? He might be told that in 1874 there were only 3,164 shareholders, whereas now there were 7,500, and therefore so many more dividend warrants to be made out. He would admit that the charges would necessarily be increased, but surely not to the extent of 100 per cent. Speaking of the legal expenses, he said what legal expenses there could be in a concern where, they were told in the report, no change had been made upon the last year's accounts, he could not conceive. £118 had been paid to lawyers this year, as against £100 last year, and he wished to know what the odd £18 was for. Stationery, printing, office expenses, and rent had increased from £330 in 1874 to £1,148 in 1885. How that increase could have taken place he could not understand.

The Chairman said it would save a great deal of explanation later on if he now stated that in 1874 there were only 1,777 shareholders, as against 7,350 now. Mr. Weatherly would surely allow that a great deal more was needed now for stationery, &c., than then.

Mr. Weatherly quite admitted the charges should be more, but £700 difference was too great for any one of the shareholders to swallow, even when they were told that the number of shareholders had increased in the way it had. Next, there was an extraordinary account of £50, broker's fee. The directors stated that no change had been made excepting that certain amounts had been paid off; whence, then, the £50 for a broker? He had been informed that in years past there had been little difficulties in the Stock Exchange in getting quotations. But why in 1885, so many years after there had been any alteration on the Stock Exchange, the gentlemen who held their purse strings should be so liberal, he did not know. They might be told that the six directors who were paid £1,500 were second to none in telegraph matters. That might be; but what had they done? According to their own figures, in 1875 the price of Anglo-Americans was 57½ to 58; now they were down to 28. The reason he went into the Globe Company was that he thought there were on the board gentlemen who knew all about the ins-and-outs of the telegraph business. He did not know what was going on, but he thought they knew, and that if they saw any positive danger to his property they would at once sell. He would be bound that the directors held none of the Anglo-American shares which they bought in the year 1875. He (Mr. Weatherly) had sold his with the exception of a small balance of £38 worth, and he had been paying those gentlemen £1,500 a year—to do what? To take care of his interests? Why, he had taken better care of them himself; he sold his Anglo-Americans when they were at a much higher price than at the present time. He had not come there merely to tell those gentlemen before their faces that they had not done rightly with his property. There were over 7,000 shareholders in the company, many of whom were clergymen and widows, who looked for their regular quarterly dividends, and it was upon the promises of the prospectus that they would have 8 per cent. that they subscribed their money; and, after all, they saw their money expended in the way he had shown. He concluded by proposing a resolution that the dividends be declared, but the accounts be not passed until examined by a committee of shareholders.

Mr. Newton enquired if the company paid income tax.

The Chairman replied that the 6 per cent. shareholders would now pay income tax.

Mr. Newton: Does the company itself pay income tax?

Mr. Birt (the solicitor): Only by way of deduction.

Mr. Newton: Then I wish to make a few remarks, because I think it is most unjustly deducted.

The Chairman thought he could explain. There was a great difference of opinion on the board, and they took counsel's opinion, which they were bound to go by. The difference was that the income tax was deducted from the 6 per cent. shareholders, and the ordinary shareholders got the benefit of it. The Anglo-American and other companies were in the same position.

Mr. Newton disputed the correctness of the action of the directors in acting upon counsel's opinion. He could bring them counsel's opinion that would tell them the very reverse. He thought the step of taking income tax from the preference shareholders should not have been taken without a judgment. Counsel's opinion was only the opinion of one, two or three individuals; but the judgment of the lowest court was binding, and nothing else was. He contended that it was illegal for any body of directors to deduct income tax and not pay it to Government.

Mr. Parnell here seconded the amendment submitted by Mr. Weatherly.

The Chairman said he was always pleased to have criticism, and more particularly when that criticism was intelligent and bore particularly upon the business of the company. He must correct one error in Mr. Weatherly's statement. He spoke of a reduction of 1 per cent.; it was only ¼ per cent.

Mr. Weatherly: Pardon me; it was 5½ in 1874, now it is 4¼.

The Chairman understood the allusion to have been to the previous dividend. But in these cases they dealt in averages, and Mr. Weatherly had been endeavouring to show that with 7,500 shareholders they should conduct the business at precisely the same expense as when they had but 2,000 shareholders to deal with. (Cries of "No, no!" from various parts of the room, and "That is an unfair way of putting it.") It was the fact all the same. At the time spoken of by Mr. Weatherly, the Anglo-American Company was in a far different position to that it now occupied. They (the Globe directors) were not responsible for the new companies which had sprung up in the Atlantic. They had in every possible way used their influence and power, as far as they possessed any, to prevent the absurd competition which had arisen; and it was that competition alone which had reduced the dividend from 5¼ at that period to 4¼ now. He could only compliment Anglo-American shareholders who had become shareholders in the Globe, for their dividend would otherwise have been 1 per cent. only instead of the dividend they now received. The shareholders in the other companies had exchanged their shares for Globe shares; they had not bought them by money. And that exchange necessitated the constant extension of their system, and necessitated also an extension of their quotation. With regard to the broker's fee of £50 spoken of, they had three times increased their capital, and it required a broker to go three times before the Stock Exchange committee before the quotation could be carried through. With regard to other expenses, when they began the company they began with a smaller number of clerks, because they had less work to be done. The amount of clerkship involved in preparing and sending out the dividend warrants was greater than any one who had not actually seen could comprehend. He considered, on the whole, that the expenses were comparatively small for a company with a capital of 3½ millions. They paid their solicitor £100 a year, and he attended every board meeting. There were constantly questions cropping up which rendered legal advice necessary, and they thought it was better to pay that £100 a year than to pay fees as they required advice, which would in the end be a much dearer mode of paying. With regard to the excess of £18 over last year's accounts, that was expended in obtaining counsel's opinion upon the income tax question. [Mr. Newton: It was not worth the money.] Probably some of the directors would agree with Mr. Newton. Still they had taken the opinion of the present Attorney-General and Mr. Rigby, and they considered that the best opinion that could be got, and they were bound to adopt it, or, their solicitor informed them, they made themselves personally responsible.

A Shareholder: Then why don't you pay that to the Government?

The Chairman, continuing, said it was a question of adjustment and not of payment. The question had been raised, and it would appear as though they were committing a fraud on the government. But before they received their payments from the other companies income-tax was deducted and paid to the Government. It was straight, although there was a great deal of complication, and they did not rob the Government of one shilling.

Mr. Newton: Certainly not. I do not say that you do.

The Chairman, proceeding, said the whole matter brought forward by Mr. Weatherly simply arose from the expenses he has referred to, and the state of things in the Atlantic. They were not responsible for what was going on in the Atlantic, but they hoped their influence would succeed in bringing about a better state of things there. Anything like an enquiry into the expenses was totally unnecessary. He might mention, in regard to the directors' fees, that they were fixed by the body of shareholders in public meeting.

A Shareholder: It was done by making use of the preference holders' votes.

Mr. Newton: As a preference shareholder, and not paying one penny of it, I think it was not my duty then to vote. It is thoroughly well known that no shareholder has fought and struggled so much against increasing directors' fees as I have; but I would rather Mr. Weatherly would not press that matter on this occasion, for I think our directors ought not to have any slight or censure passed upon them this year, for their duties are especially valuable to shareholders.

The Chairman said, without consulting his colleagues, he might state that if there was anything meant in any degree to reflect upon the present directors, they would not hold their positions for one moment. He believed they had served the shareholders well, and he believed their interests would be very materially damaged if Mr. Weatherly carried his resolution. It would be fighting the directors at a time when they required all the attention and energy of those directors. They had honest men on that board, and if they replaced them by men who would give way to all their whims and ideas their property would not be worth the paper on which it was written. The company was in a thoroughly sound state. The companies they represented were thoroughly successful, and there was no immediate prospect of a very low dividend. But there was a very great prospect, if properly handled, of bringing about such a state of things in the Atlantic as would lead to the company holding a better position than now. A charge had been brought against the directors of inviting proxies from the body of the shareholders, but they had done nothing of the kind.

After further discussion, several shareholders having expressed their satisfaction that the matters referred to by Mr. Weatherly had been brought forward, but at the same time given their opinion that it would be a better course to withdraw his motion,

Mr. Weatherly said, after the expressions just made, and with the concurrence of the seconder, he was prepared to withdraw. He was contented that he had called attention to the matter, and he hoped that next time they met they would see the accounts prepared in a very different manner. He hoped the board would feel that in the interest of the ordinary shareholders all economy must be practised that was possible, consistent with safety.

The Chairman then put the motion for the adoption of the report and accounts, and the declaration of the dividends, which was carried unanimously.

Mr. Smith submitted a motion to the effect that the directors be instructed that no proxy of the Globe Company should be given to the directors of the Anglo-American Telegraph Company at the forthcoming meeting of that company.

The Chairman remarked that notice of this motion should have been given, but he might state that the board would accept it as a recommendation, and that they had already to an extent anticipated it, for they had written to the board of the Anglo-American Company requesting them to consider seriously whether they could not do more for the shareholders, and add a little less to the reserve fund.

The retiring directors, the Marquis of Tweeddale and Mr. H. D. Gooch, and the auditors, Mr. John G. Griffiths and Mr. William Griffith, were re-elected, and, after a vote of thanks to the directors, on the motion of Mr. Weatherly, had been accorded, the meeting terminated.

Direct United States Cable Company, Limited.

THE sixteenth half-yearly general meeting of this company was held on Friday, last week, at the Cannon Street Hotel, under the presidency of Mr. J. Pender, M.P.

Mr. J. W. Fuller, secretary, having read the notice convening the meeting,

The Chairman, in moving the adoption of the report and accounts, said that the revenue for the half-year to June 30th, after deducting out payments, amounted to £36,106, and the working expenses, income tax, and other payments, exclusive of cost of repairs, absorbed £17,206, leaving a balance of £18,899, as the net profit of the half-year, making, with £17,251 brought from the previous half-year, a total of £86,150. The revenue showed a decrease of £32,467, as compared with the corresponding period of last year, owing to the operation of the reduced tariff, to competition, and to the continuation of that general commercial depression from which their business had suffered for a considerable time past. The expenses in London were slightly higher, while those at the stations were lower than in 1884. It would be observed from the accounts that this reduction in the stations' total expenditure had been effected in spite of a considerable and unavoidable increase in the item of printing and stationery. They had incurred special outlay on law account during the past half-year, but the matters in question were finally settled prior to June 30th. The reserve fund, after being charged with £2,858 for cost of repairs, now amounted to £310,000. The company's investments amounted to £304,921, and the present market value of the securities was in excess of their cost to the company. When he last had the pleasure of addressing the shareholders he told them that the reduction of the rate from 2s. to 1s. 8d. per word would involve a loss of at least £150,000 a year. That statement had been fully confirmed, and, more than that, there had been no corresponding increase of traffic to recoup the loss. The depression of trade in America had still further tended to reduce the gross traffic, so that during the six months the traffic and returns had steadily declined. At the last meeting he mentioned that the two new cables introduced by Messrs. Mackay and Bennett were entirely superfluous, and those cables had done nothing to create new traffic, but had simply taken away

a portion of the current earnings which had been lessened by their hasty and ill-advised reduction. During the last six months the companies working in concert with them had all had their cables interrupted more or less. In fact, they had had to work at different periods with six, five and four cables respectively, instead of with eight. Therefore, the proportion going to the two new cables might appear to the proprietors of those cables more satisfactory than they really were, because, had the Direct Company been working with all its cables, the receipts to the competing lines would have been proportionately less. But, even as it was, their earnings had probably amounted to about 28 per cent. of the receipts, a state of things which could not possibly give satisfaction. One of the Western Union cables and that of the French Company were still broken, but they would no doubt be shortly repaired, so that a reduction of the Bennett-Mackay proportion must follow. When he last addressed them he told them to be prepared to look a reduced dividend in the face. That reduced dividend, he was sorry to say, had come about. They were therefore in the position of either having a higher rate or being obliged for a time to make a considerably lower one, because to work at the present tariff with no immediate prospect of any increase in the traffic, the directors considered, as men of business, would be unwise. He was, however, hopeful that when those interested in the Mackay-Bennett venture found that the business was so unsatisfactory, they would be anxious to come to some understanding which would increase their earnings. Having referred to the very great competition now going on between the land lines in America, he went on to show that before a permanent settlement of the submarine system could be made there must be some arrangement come to by the land line companies. He hoped before the next meeting he would be able to put before them a statement with brighter prospects. He concluded by formally moving the adoption of the report, carrying with it the recommendation of a dividend of 3s. per share, making 4 per cent. for the year.

Mr. Wm. Ford seconded the motion.

Mr. W. Newton deprecated any concessions being made to the new company. There would be no peace unless they showed their determination to fight these companies which were constantly starting up in opposition.

After some further observations on the same subject from other shareholders, the Chairman said they would exhaust every resource to come to an amicable arrangement, as they did not wish to throw away the shareholders' money; but, if it was necessary to do so they would find that he (the chairman) was ready to fight, and that he had good fighting stuff in him.

The motion for the adoption of the report was then put and agreed to unanimously.

The Edison and Swan United Electric Light Company, Limited.

THE following report was brought forward on Friday, at the second annual general meeting of this company:—

The directors have pleasure in presenting to the shareholders the accounts for the year ending 30th June, 1885.

These accounts show that the hope which the directors expressed in the last report, as to the probability of an improvement in the company's affairs, has been fully realised.

The profit and loss account for the year, after making allowances for bad and doubtful debts and depreciation of plant, shows a balance of profit of £12,353 15s. 9d.

The shareholders will remember that the result of the working out of the contracts and obligations which the company took over from the old companies, showed a loss of £28,214 2s. 6d., for the year ending 30th June, 1884.

The company at its formation took over the Swan Company's factories at Newcastle. These buildings are not well adapted for the manufacture of lamps, and the Insurance Companies have classed the Benwell Factory as a dangerous risk, involving the payment of an exceptionally high premium. With a view to economical manufacture, and more efficient supervision, the directors have purchased, on favourable terms, a freehold factory in the neighbourhood of London, not open to the objections made by the Insurance Companies, and hope to transfer the lamp manufactory from Newcastle to London in the coming autumn.

The lamp factory at Newcastle has been working to its utmost capacity. The lamps which have recently been made, when properly and carefully run, are lasting for a great number of hours. The returns from the Admiralty and other customers, as to the duration of life of the lamps supplied by the company, are very satisfactory.

The installations which the company have carried out during the past year have resulted in a profit, and there are indications that the number of installations will be increased during the coming autumn and winter. During the past year the company have installed the electric light on 17 ships with success. They have also installed plant for incandescent light in private houses, railway stations, and mills, in every case selling the plant when completed.

The directors have followed the policy announced to the shareholders at the last meeting, of closing rental installations whenever opportunity offered. The contracts for lighting the Glasgow Post Office and Messrs. Gartside's works have terminated during the course of the year, and have not been renewed. Since the formation of this company, the directors have not entered into any fresh arrangements for lighting on a rental basis, and they will put an end to the existing contracts at the earliest moment that they have power to do so.

The action which the company has commenced against Messrs. Woodhouse and Rawson for infringement of their patents is down for hearing, and will probably be tried in November.

The Board of Trade, in the month of May last, cancelled the provisional orders which were held by the company. Before operations could have been begun under these orders, it would have been necessary for the company to have deposited or found security for £48,800. This large sum only represents a very small portion of the outlay which would have been required to establish central stations in London. Not a single central station has been established in London under the Electric Lighting Act of 1882. The shareholders are aware that a deputation had an interview with the President of the Board of Trade in the hope that he would agree to amend the Act in question, and a committee was formed with a view of preparing an amended Act, in which proceedings the company took an active part. Nothing has, however, been settled, and the question has now been left to be dealt with by the new Parliament.

In conclusion, the directors will in the future, as in the past year, refrain from entering into unprofitable rivalry with other companies and firms, they will only undertake work in which there is a prospect of making a fair profit, and they appeal to the shareholders to assist them in endeavouring to obtain orders for installations and lamps.

Mr. J. S. Forbes and Mr. F. R. Leyland retire from the board, and will offer themselves for re-election as directors.

[Our report of the meeting of the shareholders will appear next week.]

Brazilian Submarine Telegraph Company, Limited.—This company gives notice that the coupons on its Five per Cent. debentures, due the 31st July, will be paid on and after that date at the Alliance Bank.

Eastern Telegraph Company, Limited.—This company notifies that the coupons on its Five per Cent. debentures, due August 1st, will be paid on and after that date at the banking house of Messrs Glyn, Mills, Currie and Co., Lombard Street.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 25th, were £2,158, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1885.

8788. "Electric cable recorders." M. G. FARMER. Dated July 21. (*Complete.*)

8808. "Application of electricity to the treatment of vegetable fibre for the production of half stuff and other purposes." W. B. NATION. Dated July 21.

8811. "Synchronous movements and telegraphy." P. B. DELANY. Dated July 21.

8812. "Synchronous multiplex printing telegraphy." S. PITT. (Communicated by P. B. Delaney.) Dated July 21. (*Complete.*)

8813. "Telegraphic relays." P. B. DELANEY. Dated July 21. (*Complete.*)

8823. "Primary batteries." J. NOAD. Dated July 21.

8827. "Utilising electric clocks for advertising purposes. J. ALLEN. Dated July 22. (*Complete.*)

8841. "Controlling and automatically partially working by means of electricity railway distant and other signals." W. E. LANGDON. Dated July 22.

8860. "Insulators for electrical apparatus." B. PELL. Dated July 22.

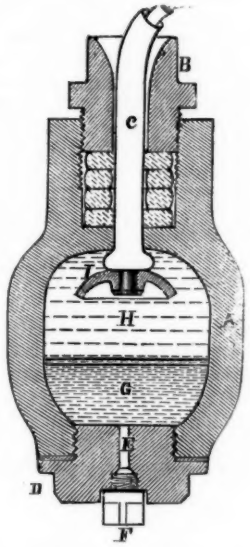
8861. "Electric generators for charging secondary batteries and other purposes and the arrangement of circuit connections to be used therewith." E. and A. E. JONES. Dated July 22.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

1439. "Improvements in electric clocks." A. W. RIXON and R. THEILER. Dated February 2. 4d. Relates to an electric clock of very simple construction and reliable action.

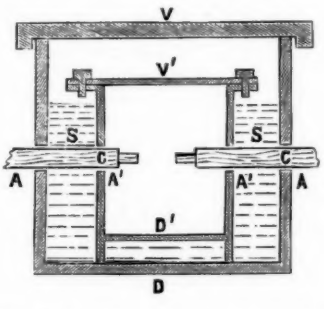
1784. "Improvements connected with submarine cable grapnels for ascertaining when the grapnel is on the sea bottom." Sir J. ANDERSON and A. E. KENNELLY. Dated February 9. 6d. The fig. shows a vertical section of one arrangement of the apparatus for carrying out the invention. A is a closed vessel, having a stuffing box at B, through which an insulated conductor, C, connected with

the grapnel rope passes in a water tight manner into the vessel, which also has an opening at bottom hermetically closed by a screwed cap, D, in which is a small passage, E, closed by a screwed plug, F. On removing the cap, D, access is gained to the conductor, while the small passage, E, serves for the introduction of mercury, G, and oil, H, with which the vessel is entirely filled. To the inner end of the conductor, C, is secured the metal cup, I,



so that when by reason of the metal vessel, A, being in contact with the bottom of the sea, it is made to assume an inclined position, the mercury, G, comes in contact with the edge of the cup, I, thus establishing electrical communication between the conductor, C, and the metal vessel, which, being surrounded by sea water, makes an efficient electrical earth connection, and causes a signal to be actuated on board ship through the conductor. When the vessel, A, assumes a vertical or nearly vertical position, in consequence of its leaving the sea bottom, or being on the point of doing so, the contact between the mercury and the cup will cease, and the consequent cessation of the current will at once indicate the fact on board ship, thus giving notice that more rope is required to be payed out.

2263. "Making watertight boxes placed in the ground for the electrical testing of underground electrical conductors, and for giving origin to other conductors." E. W. BECKINGSALE. Dated February 19. 4d. D, D 1 are two boxes of cast iron, steel, lead, brass, or other metal, these boxes are placed one within the other, the outer one, D, being of sufficient strength to resist the traffic of the roads or other disturbing influences, the inner one, D 1, is to receive the boxed conductor, and is made watertight in the



manner to be described. The conductors, C, are admitted through apertures, A, A 1, in the sides of the boxes, D, D 1. When the conductors, C are secured in their positions in the boxes, D, D 1, the apertures, A 1, which are not entirely closed by the admission of the conductors, are made watertight by either of the following processes:—Resin, tar, pitch, paraffin, wax or grease, or an admixture of two or more of these substances is poured into the space, S, between the boxes, filling it up to nearly the top of the inner box, D 1, and allowed to solidify, the space left in the aperture between the inner box and the conductor being first filled with a substance having a higher melting point than the material poured in.

2388. "Improvements in machinery for paying out or picking up submarine electric telegraph cables." W. C. JOHNSON and S. E. PHILLIPS. Dated February 21. 2d. In paying out or picking up machinery for electric telegraph cables, as at present constructed, the cable is led over a large drum carried on a high framing entirely above the upper deck of the ship, and the steam engines for driving the drum are also arranged above the deck. By thus making the heavy structure of the drum and framing project to a considerable distance above the deck, the ship is rendered top heavy and unseaworthy; and, moreover, the cable passing from or to the paying-out or picking-up drum, to or from the guide pulley at the bows, is at such a considerable height as to be out of the reach of the attendants, and can consequently not be efficiently watched and manipulated. According to the present invention the inventors obviate these inconveniences by constructing and arranging the said machinery in the following manner:—They arrange the bearings for the axis of the drum or drums upon a suitable framing on the upper deck, so that the drum only projects to less than half its diameter above the deck. The driving engines, with the speed reducing gear, can by this arrangement be placed on the lower deck of the ship, the framing thereof being connected to that on the upper deck, and thus the centre of gravity of the entire machine is brought very considerably lower down, while the framing, in being thus made to constitute a part of the ship, adds materially to its strength as a structure, instead of forming an element of weakness thereto on account of its great weight. Also, by this arrangement, the greater portion of the machine is protected by being between decks, in addition to which the advantage is gained of having the cable passing from the drum so low down as to be well within the reach of the attendants.

2587. "Improved means for regulating electromotive force in the various parts of a system of mains used for electric distribution." J. E. H. GORDON. Dated February 25. 4d. In the specification of a former patent granted, No. 5624, in the year 1884, the inventor described a new form of electric main for supplying an electric current to two or more "distant points" or "distributing centres" at a distance from a dynamo or system of connected dynamos—such electric mains consisting not of one large cable, but of several smaller ones, and of apparatus for disconnecting these cables as required for the purpose of keeping the electromotive force at each centre unchanged in spite of changes in the number of lamps supplied from it. The present invention consists in another method of carrying out the requirements described in the specification above mentioned. Instead of the main consisting of a number of separate components as in that specification, it is made to consist of a single main or a group of wires connected as a single main, and the regulation is done by the insertion of resistances either at the dynamo end or the far end, or any intermediate point. The insertion of a resistance produces the same electrical effect as the cutting off of component cables.

2596. "Improvements relating to the distribution of electricity employed in district lighting." J. E. H. GORDON. Dated February 25. 4d. Relates to the construction of a switch board employed at distributing centres.

2639. "Spring terminal for electric wires." B. PELL. Dated February 26. 4d. Relates to a construction of terminals or contact posts in which, instead of a pinching screw, a spring is employed to grip the wire between contact surfaces, thereby giving certainty of action, ensuring good contact and preventing loosening by vibration, affording besides facilities for attaching two or more wires to the same terminal.

2818. "Improvements in electrical conductors." C. A. DAY. (Communicated from abroad by H. F. Campbell, of America.) Dated March 3. 6d. Consists partly in connecting together at their ends the anti-inductive shields of two independent cables. The invention further consists in connecting the telephone or other instrument in circuit between one of the independent wires of the cable and the anti-inductive shield, composed mainly of para-magnetic material, of the said wire or cable. The invention further consists in an insulated conductor, provided with two concentric anti-inductive shields, composed mainly of para-magnetic material, insulated from one another, and electrically connected together at the ends of the cable so as to form a complete metallic circuit traversing the entire length of the cable.

2826. "Improvements in electrical shell fuse for projectiles." E. L. ZALINSKI. Dated March 3. 6d. Consists in a shell fuse in which an electrical battery or generator contained within the projectile serves to ignite the firing charge or detonator.

2878. "Improvements in electric rotary brushes." W. S. FROST, J. L. MERIGOT, and G. C. C. FEIN. Dated March 4. 6d. Relates to the production of an electric rotary brush to be used with and worked by ordinary or any suitable rotary hair brushing machinery, and capable of applying the galvanic, voltaic induction, medical, magneto static, and other electric currents to the head and different parts of the body, for the purpose of accelerating the growth of hair, and the cure of those diseases to which the human body or that of animals is subject, and where electricity as a remedy is or may be applicable.

2893. "Improvements in telephonic transmitters." C. D. ABEL. (Communicated from abroad by La Société Générale de Telephones (Resaux Telephoniques et Constructions Electriques, of Paris). Dated March 4. 4d. The vibrating plates of the telephonic microphone transmitters are constructed of artificial carbon, prepared either from retort carbon or from graphite, such carbon vibrating plates offering the advantage over wooden plates of transmitting speech with a more natural sound. In addition they admit of a considerable simplification of the construction of the microphone, as this consists only of arranging between the two carbon plates the carbon button or other material that unites the two carbon plates, and serves for the transmission of the electric current.

CORRESPONDENCE.

Induction or Leakage.

In re "Induction or Leakage" in your last issue, your correspondent, W. J. Sandy, Esq., is evidently labouring under a false impression.

1. He cannot understand why lead foil is laid along the length of telephone cable. Surely every novice in electricity knows that induction is minimised by laying a conductor (in this instance lead foil) in proximity to the cable, the said conductor being put to earth. Another way of attaining the same end is to use a going and return wire for the circuit, twisting one around the other, and the above methods have been known to electricians for many years.

2. He takes the paragraph which informs him that the "plan covers any accidental use of imperfect material," and then tacks an absurd inference on to it.

If anyone is guilty of confounding "leakage with induction" it certainly is not the patentee of the cables.

The obvious meaning of the paragraph is, that if the insulating material is imperfect in any way, the wires still remain insulated.

It is even possible to melt all the composition off the cables and yet run no risk of short circuit, and why? Because the wires are woven in cloth, and can never come together with ordinary usage; even if all the insulating compound is taken away, there still remains the cloth, which keeps all the wires at a uniform distance, and when I mention that such an eminent authority as Sir Charles Bright (using his name without permission) has expressed a favourable opinion on the patents, "W. J. S." may be induced to look further into the merits of Mr. Sellars's inventions.

T. Angelo.

Polytechnic Sci. Classes,
309, Regent Street, 28*th July*, 1885.

P.S.—I may add that I am not interested in the matter in any way, and also believe that other parties hold patents for attaining the same ends by different methods. I regret that I have not the time to answer the letter fully, but perhaps Mr. Sellars may find time to administer the *coup de grace*.

Experiments with Arc Lamps.

Some time ago I made certain experiments which may perhaps be of use to some of your readers. Unfortunately I have no works in London where I could follow up seriously these experiments.

I tried to combine the light of coal gas and electricity, and carried it out in the following manner:—

To pass the jet of coal gas right through the arc, I used hollow carbon rods, and the gas flame and the electric arc could be seen distinctly burning side by side. When the arc was burning the flame of the gas diminished to a certain extent, but the gas jet seemed not at all to increase the light of the arc, and a good deal of carbon was deposited at the end of the carbon rods. Therefore, I think that by well proportioning the carbon rods, the gas jet and the electric current, it might perhaps be possible to replace the wear of the carbon rods by the carbon deposited from the gas, and thus do away with the feeding mechanism in the arc lamps.

The gas may also be decomposed by passing it through a carbon tube made incandescent.

It is likely that a jet of oxygen might greatly increase the light of the arc, though of course the carbons would burn away more rapidly. At all events, it seems to me that this apparatus may be very useful for chemical purposes, in the composition and decomposition of certain gases.

G. A. Nussbaum.

London, 25*th July*, 1885.

Meardi's Mercurial Amperemeter.

May I venture to trouble you for an explanation in reference to a note which made its appearance in the columns of your esteemed journal of the 18th inst., in reference to the above instrument having been anticipated by a similar one invented by Mr. Miller, of the Gérard Company. Not unlike many of your readers, I suppose, I myself feel rather interested in these kind of instruments, which seem not unlikely to play an important role in practical electric measurement in the immediate future.

Three years ago I experimented in my workshop with a similar instrument to the above named, but unfortunately, the results of my experiments were far from satisfactory, and, of course, I, for obvious reasons, never ventured to publish them, just as many others may, I infer, have done the same contemporaneously.

Without the least intent of gratifying any personal ambition, nor wresting a single item of Meardi's legitimate claim to priority, or throwing any doubt on the said note of yours, may I ask where and when such instrument as you mention has been described to the public, and whether any record exists to corroborate and warrant the assertion thereof?

I know of no others but Lippman's, which, though of the same class, is by no means of the same type.

Anticipating my thanks for your kind attention,

A. E. Conti.

Charlton, 25*th July*, 1885.

[Our information was received from a well known firm of electric light engineers whose offices are in London, but the following letter will doubtless give our correspondent all the particulars he desires.—EDS. ELEC. REV.]

Will you allow me to state, in reply to the letter of M. Meardi in your last week's issue, that the English patent for my ampéremeter, that indicates the current by the height of a column of liquid, bears date January 16th, 1884, but that I did not take out a patent in Italy. The instrument itself may be seen at my stand in the East Arcade of the Inventions Exhibition. Where it can be made a fixture, or in laboratories, it is very useful, as the scale is long, and it gives very dead-beat indications, but as a portable electric light instrument it leaves something to be desired, and I have, therefore, since brought out a much smaller meter with an aluminium pointer.

It may be of interest to note that an unexpected difficulty arose in the construction of the liquid meter through the tendency of mercury to assume a globular state when shaken up with another liquid, when the two have been together for some time. Sealed up inside the glass tube of the instrument there is mercury, iron, and another liquid. Of all those I have tried pure benzine $C_6 H_6$ is the only one that will allow of the meter being turned upside down and shaken, as during a railway journey, without the mercury breaking up into globules and remaining in that state. The method I mention in my specification for obtaining a vertical movement strictly proportional to current strength, by floating the core of a solenoid in mercury and placing outside the iron an ebonite tube turned to the proper shape, may also be useful for other applications.

With regard to M. Meardi's method of sounding an alarm when the volts at the lamps exceed what they require, it is without doubt a step in the right direction, as the usual plan of watching a pilot lamp is not very satisfactory. Following another inventor I have adapted my own voltmeter (second patent) so that the needle will move through the whole scale with a difference of about four volts. A sensitive volt *indicator* is all that is required when an installation has once been properly made.

L. Miller.

82, Hatton Garden, E.C.,
25*th July*, 1885.